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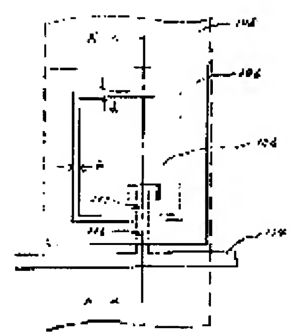
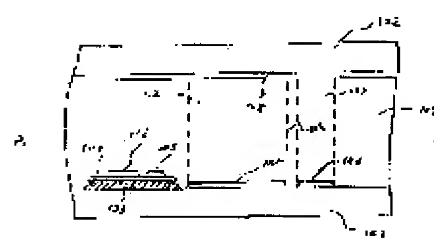
(54) LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:
PURPOSE: To separately control the effective voltages impressed on a liquid crystal layer and to improve visual angle characteristics by bisecting a liquid crystal driving electrode and driving the bisected liquid crystal driving electrodes with respectively independent MIM elements.
CONSTITUTION: The liquid crystal driving electrode is bisected to the first pixel electrode 105 which is one kind of first nonlinear type resistance elements and the second pixel electrode 106 which is one kind of second nonlinear resistance elements. The second pixel electrode 106 is formed in the peripheral part of the first pixel electrode 105 and is further driven by the respectively independent first MIM element 111 and the second MIM element 110. In such a case, the effective voltages impressed on the liquid crystal layer 112 and the liquid crystal layer 113 change and the visual angle characteristic is improved if the ratio of the capacitance the of the liquid crystal layer 112 driven by the first pixel electrode 105 and the capacitance of the first MIM element 111 and the ratio of the capacitance-of the liquid crystal layer 113 driven by the second pixel electrode 106 and the capacitance of the second MIM element is so set as to be varied. The contrast ratio is compensated by the liquid crystal layer 113, by which the visual field angle is widened.





CLAIMS

[Claim(s)]

[Claim 1]Said liquid crystal driving electrode in a liquid crystal display characterized by comprising the following The first picture element electrode, the second picture element electrode formed in a periphery of said first picture element electrode, and the first which is come out of and constituted and drives said first picture element electrode and said second picture element electrode, respectively -- the [a non-line type resistance element and] -- a liquid crystal display providing a 2 non-line type resistance element.
A non-line type resistance element.
A liquid crystal driving electrode which drives a liquid crystal.

[Claim 2]said first -- the [a non-line type resistance element and / said] -- a 2 non-line type resistance element, When it has the structure which laminated a conductor-insulator-conductor one by one, each non-line type resistance element area is made into S_{NL1} and S_{NL2} and area of S_{LC1} and said second picture element electrode is made into S_{LC2} for area of said first picture element electrode, The liquid crystal display according to claim 1 filling $S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$.

[Claim 3]said first -- the [a non-line type resistance element and / said] -- a 2 non-line type resistance element, Have the structure which laminated a conductor-insulator-conductor one by one, and each non-line type resistance element capacity C_{NL1}, It is considered as C_{NL2}, capacity of a liquid crystal layer which drives capacity of a liquid crystal layer driven with said first picture element electrode with C_{LC1} and said second picture element electrode is made into C_{LC2}, and it is $C_{LC2}/C_{NL2}=m_1\,(C_{LC1}/C_{NL1})$.
The liquid crystal display according to claim 1 characterized by there being the range of a value of m_1 from 0.001 to 0.999 when an upper type defines coefficient m_1.

[Claim 4]said first -- the [a non-line type resistance element and / said] -- a 2 non-line type resistance element, When it has the structure which laminated a conductor-insulator-conductor one by one, each non-line type resistance element area is made into S_{NL1} and S_{NL2} and area of S_{LC1} and said second picture element electrode is made into S_{LC2} for area of said first picture element electrode, The liquid crystal display according to claim 1 filling $S_{LC1}=S_{LC2}$ and $S_{NL1}<S_{NL2}$.

[Claim 5]It is a ratio to area $S_{LC1}+S_{LC2}$ which set said first picture element electrode and said second picture element electrode of said first pixel electrode area S_{LC1} kappa$_1$ (when it is considered as kappa$_1$=$S_{LC1}/(S_{LC1}+S_{LC2})$) The liquid crystal display according to claim 2, wherein a value of kappa$_1$ is from 0.1 to 0.9.

[Claim 6]said first -- the [a non-line type resistance element and / said] -- a 2 non-line type resistance element, When it has the structure which laminated a conductor-insulator-conductor one by one, each non-line type resistance element area is made into S_{NL1} and S_{NL2} and area of

S_{LC1} and said second picture element electrode is made into S_{LC2} for area of said first picture element electrode, The liquid crystal display according to claim 1 filling $S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$.
[Claim 7]said first -- the [a non-line type resistance element and / said] -- a 2 non-line type resistance element, Have the structure which laminated a conductor-insulator-conductor one by one, and each non-line type resistance element capacity C_{NL1}, It is considered as C_{NL2}, capacity of a liquid crystal layer which drives capacity of a liquid crystal layer driven with said first picture element electrode with C_{LC1} and said second picture element electrode is made into C_{LC2}, and it is $C_{LC1}/C_{NL1}=m_2\,(C_{LC2}/C_{NL2})$.
The liquid crystal display according to claim 1 characterized by there being the range of a value of m_2 from 0.001 to 0.999 when an upper type defines coefficient m_2.
[Claim 8]said first -- the [a non-line type resistance element and / said] -- a 2 non-line type resistance element, When it has the structure which laminated a conductor-insulator-conductor one by one, each non-line type resistance element area is made into S_{NL1} and S_{NL2} and area of S_{LC1} and said second picture element electrode is made into S_{LC2} for area of said first picture element electrode, The liquid crystal display according to claim 1 filling $S_{LC1}=S_{LC2}$ and $S_{NL1}>S_{NL2}$.
[Claim 9]When a ratio to area $S_{LC1}+S_{LC2}$ which set the first picture element electrode and the second picture element electrode of said second pixel electrode area S_{LC2} is made into $kappa_2$, it is $kappa_2=S_{LC2}/(S_{LC1}+S_{LC2})$.
The liquid crystal display according to claim 6, wherein a value of $kappa_2$ is from 0.1 to 0.9.
[Claim 10]A liquid crystal display which each of said liquid crystal driving electrode is divided into two or more picture element electrodes in a liquid crystal display used as two or more one liquid crystal driving electrodes of a component formed in matrix form since a liquid crystal is driven, and is characterized by the separation distance d between these picture element electrodes being 10 micrometers or less.
[Claim 11]Two or more liquid crystal driving electrodes formed in matrix form since a liquid crystal was driven.
Structure which laminated a conductor-insulator-conductor one by one.
Are the liquid crystal display provided with the above, and said liquid crystal driving electrode is divided in the direction asked for a wide viewing angle of said liquid crystal display at n picture element electrodes (integer of n>=2), When area of a non-line type resistance element which a non-line type resistance element was provided in its **** of this picture element electrode, and considered it as area S_{LCi} of the i-th picture element electrode (i is the arbitrary integers between 1 and n), and was provided in the i-th picture element electrode is made into S_{NLi}, It is characterized by a value of S_{LCi}/S_{NLi} of n pieces being at least two or more kinds.

[Claim 12]The liquid crystal display according to claim 11, wherein said liquid crystal driving electrode is divided into n picture element electrodes (integer of n>=2) to a horizontal direction of said liquid crystal display.
[Claim 13]The liquid crystal display according to claim 11, wherein said liquid crystal driving electrode is divided into n picture element electrodes (integer of n>=2) to a perpendicular direction of said liquid crystal display.
[Claim 14]Claim 11, wherein said i-th value of S_{LCi}/S_{NLi} and the n+1-i-th values of $S_{LC(n+1-i)}/S_{NL(n+1-i)}$ are equal and claim 12, the liquid crystal display according to claim 13.
[Claim 15]Claim 11, wherein said liquid crystal driving electrode is trichotomized and claim 12, claim 13, the liquid crystal display according to claim 14.
[Claim 16]Two or more liquid crystal driving electrodes formed in matrix form since a liquid crystal was driven.

Structure which laminated a conductor-insulator-conductor one by one.
It is the liquid crystal display provided with the above, and is characterized by having divided said liquid crystal driving electrode into the first picture element electrode and the second picture element electrode, and said second picture element electrode's having enclosed said first picture element electrode, and said a part of second picture element electrode having extended inside said first picture element electrode.

[Claim 17]Area of S_{LC1} and said second picture element electrode for area of said first picture element electrode S_{LC2}. The liquid crystal display according to claim 16 characterized by filling $S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$ when area of a non-line type resistance element in which area of a non-line type resistance element provided in said first picture element electrode was provided by S_{NL1} and said second picture element electrode is made into S_{NL2}.
[Claim 18]said first -- the [a non-line type resistance element and / said] -- a 2 non-line type resistance element, Have the structure which laminated a conductor-insulator-conductor one by one, and each non-line type resistance element capacity C_{NL1}. It is considered as C_{NL2}, capacity of a liquid crystal layer which drives capacity of a liquid crystal layer driven with said first picture element electrode with C_{LC1} and said second picture element electrode is made into C_{LC2}, and it is $C_{LC2}/C_{NL2}=m_1$ (C_{LC1}/C_{NL1}).
The liquid crystal display according to claim 16 characterized by there being the range of a value of m_1 from 0.001 to 0.999 when an upper type defines coefficient m_1.
[Claim 19]Area of S_{LC1} and said second picture element electrode for area of said first picture element electrode S_{LC2}. When area of a non-line type resistance element in which area of a non-line type resistance element provided in said first picture element electrode was provided by S_{NL1} and said second picture element electrode is made into S_{NL2}. The liquid crystal display according to claim 16 filling $S_{LC1}=S_{LC2}$ and $S_{NL1}<S_{NL2}$.
[Claim 20]When a ratio to area $S_{LC1}+S_{LC2}$ which set said first picture element electrode and said second picture element electrode of said first pixel electrode area S_{LC1} is made into $kappa_1$ $(kappa_1=S_{LC1}/(S_{LC1}+S_{LC2}))$. The liquid crystal display according to claim 17, wherein a value of $kappa_1$ is from 0.05 to 0.8.
[Claim 21]Area of S_{LC1} and said second picture element electrode for area of said first picture element electrode S_{LC2}. The liquid crystal display according to claim 16 characterized by filling $S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$ when area of a non-line type resistance element in which area of a non-line type resistance element provided in said first picture element electrode was provided by S_{NL1} and said second picture element electrode is made into S_{NL2}.
[Claim 22]said first -- the [a non-line type resistance element and / said] -- a 2 non-line type resistance element, Have the structure which laminated a conductor-insulator-conductor one by one, and each non-line type resistance element capacity C_{NL1}. It is considered as C_{NL2}, capacity of a liquid crystal layer which drives capacity of a liquid crystal layer driven with said first picture element electrode with C_{LC1} and said second picture element electrode is made into C_{LC2}, and it is $C_{LC1}/C_{NL1}=m_2$ (C_{LC2}/C_{NL2}).
The liquid crystal display according to claim 16 characterized by there being the range of a value of m_2 from 0.001 to 0.999 when an upper type defines coefficient m_2.
[Claim 23]Area of S_{LC1} and said second picture element electrode for area of said first picture element electrode S_{LC2}. When area of a non-line type resistance element in which area of a non-line type resistance element provided in said first picture element electrode was provided by S_{NL1} and said second picture element electrode is made into S_{NL2}. The liquid crystal display

according to claim 16 filling $S_{LC1}=S_{LC2}$ and $S_{NL1}>S_{NL2}$.

[Claim 24]When a ratio to area $S_{LC1}+S_{LC2}$ which set the first picture element electrode and the second picture element electrode of said second pixel electrode area S_{LC2} is made into $kappa_2$, it is $kappa_2=S_{LC2}/(S_{LC1}+S_{LC2})$.

The liquid crystal display according to claim 21, wherein a value of $kappa_2$ is from 0.2 to 0.95.

[Claim 25]Two or more liquid crystal driving electrodes formed in matrix form since a liquid crystal was driven.

Structure which laminated a conductor-insulator-conductor one by one.

Are the liquid crystal display provided with the above, and said liquid crystal driving electrode is divided into the first picture element electrode and the second picture element electrode, It is characterized by said second picture element electrode's having enclosed said first picture element electrode, said a part of second picture element electrode's having extended inside said first picture element electrode, and also said a part of first picture element electrode having extended inside said second picture element electrode.

[Claim 26]Area of S_{LC1} and said second picture element electrode for area of said first picture element electrode S_{LC2}, The liquid crystal display according to claim 25 characterized by filling $S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$ when area of a non-line type resistance element in which area of a non-line type resistance element provided in said first picture element electrode was provided by S_{NL1} and said second picture element electrode is made into S_{NL2}.

[Claim 27]said first -- the [a non-line type resistance element and / said] -- a 2 non-line type resistance element, Have the structure which laminated a conductor-insulator-conductor one by one, and each non-line type resistance element capacity C_{NL1}, It is considered as C_{NL2}, capacity of a liquid crystal layer which drives capacity of a liquid crystal layer driven with said first picture element electrode with C_{LC1} and said second picture element electrode is made into C_{LC2}, and it is $C_{LC2}/C_{NL2}=m_1\ (C_{LC1}/C_{NL1})$.

The liquid crystal display according to claim 25 characterized by there being the range of a value of m_1 from 0.001 to 0.999 when an upper type defines coefficient m_1.

[Claim 28]Area of S_{LC1} and said second picture element electrode for area of said first picture element electrode S_{LC2}, When area of a non-line type resistance element in which area of a non-line type resistance element provided in said first picture element electrode was provided by S_{NL1} and said second picture element electrode is made into S_{NL2}, The liquid crystal display according to claim 25 filling $S_{LC1}=S_{LC2}$ and $S_{NL1}<S_{NL2}$.

[Claim 29]When a ratio to area $S_{LC1}+S_{LC2}$ which set said first picture element electrode and said second picture element electrode of said first pixel electrode area S_{LC1} is made into $kappa_1$, it is $kappa_1=S_{LC1}/(S_{LC1}+S_{LC2})$.

The liquid crystal display according to claim 26, wherein a value of $kappa_1$ is from 0.1 to 0.9.

[Claim 30]Area of S_{LC1} and said second picture element electrode for area of said first picture element electrode S_{LC2}, The liquid crystal display according to claim 25 characterized by filling $S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$ when area of a non-line type resistance element in which area of a non-line type resistance element provided in said first picture element electrode was provided by S_{NL1} and said second picture element electrode is made into S_{NL2}.

[Claim 31]said first -- the [a non-line type resistance element and / said] -- a 2 non-line type resistance element, Have the structure which laminated a conductor-insulator-conductor one by one, and each non-line type resistance element capacity C_{NL1}, It is considered as C_{NL2}, capacity of a liquid crystal layer which drives capacity of a liquid crystal layer driven with said first picture

element electrode with C_{LC1} and said second picture element electrode is made into C_{LC2}, and it is $C_{LC1}/C_{NL1}=m_2 (C_{LC2}/C_{NL2})$.
The liquid crystal display according to claim 25 characterized by there being the range of a value of m_2 from 0.001 to 0.999 when an upper type defines coefficient m_2.
[Claim 32]Area of S_{LC1} and said second picture element electrode for area of said first picture element electrode S_{LC2}. When area of a non-line type resistance element in which area of a non-line type resistance element provided in said first picture element electrode was provided by S_{NL1} and said second picture element electrode is made into S_{NL2}. The liquid crystal display according to claim 25 filling $S_{LC1}=S_{LC2}$ and $S_{NL1}>S_{NL2}$.
[Claim 33]When a ratio to area $S_{LC1}+S_{LC2}$ which set the first picture element electrode and the second picture element electrode of said second pixel electrode area S_{LC2} is made into $kappa_2$, it is $kappa_2=S_{LC2}/(S_{LC1}+S_{LC2})$.
The liquid crystal display according to claim 30, wherein a value of $kappa_2$ is from 0.1 to 0.9.
[Claim 34]Two or more liquid crystal driving electrodes formed in matrix form since a liquid crystal was driven.
Structure which laminated a conductor-insulator-conductor one by one.
It is the liquid crystal display provided with the above, and said liquid crystal driving electrode is divided into n concentric picture element electrodes (integer of n>=2), and it is characterized by providing a non-line type resistance element in its **** of this concentric picture element electrode.

[Claim 35]When area of a non-line type resistance element which considered it as area S_{LCi} of the i-th concentric picture element electrode (i is the arbitrary integers between 1 and n) of said concentric picture element electrode, and was provided in the i-th concentric picture element electrode is made into S_{NLi}. The liquid crystal display according to claim 34, wherein a value of S_{LCi}/S_{NLi} of n pieces is at least two or more kinds.
[Claim 36]The liquid crystal display according to claim 34, wherein there is minimum width of said n concentric picture element electrodes (integer of n>=2) by 3 or more times of separation distance between these concentric picture element electrodes.
[Claim 37]The liquid crystal display according to claim 34 which the maximum width of said n concentric picture element electrodes (integer of n>=2) is 5 micrometers or less, and is characterized by there being separation distance between these concentric picture element electrodes at 1 micrometer or less.
[Claim 38]It is considered as area S_{LCi} of the i-th concentric picture element electrode (i is the arbitrary integers between 1 and n) of said concentric picture element electrode, Area of a non-line type resistance element provided in the i-th concentric picture element electrode is made into S_{NLi}. Use as the first picture element electrode a picture element electrode located in the innermost part, and a non-line type resistance element linked to it is named the first MIM element, a picture element electrode and a non-line type resistance element which set to the second and the third as it progresses outside one by one below, and are located in the outermost part -- respectively -- the [the n-th picture element electrode and] -- a time of considering it as a nMIM element -- S_{LCi}/S_{NLi} -- the liquid crystal display according to claim 34 filling $<S_{LCi+1}/S_{NLi+1}$.
[Claim 39]The liquid crystal display according to claim 38, wherein all of area of said n non-line type resistance elements are equal.
[Claim 40]The liquid crystal display according to claim 38, wherein all of area of said n concentric picture element electrodes are equal.
[Claim 41]It is considered as area S_{LCi} of the i-th concentric picture element electrode (i is the

arbitrary integers between 1 and n) of said concentric picture element electrode, Area of a non-line type resistance element provided in the i-th concentric picture element electrode is made into S_{NLi}, Use as the first picture element electrode a picture element electrode located in the innermost part, and a non-line type resistance element linked to it is named the first MIM element, a picture element electrode and a non-line type resistance element which set to the second and the third as it progresses outside one by one below, and are located in the outermost part -- respectively -- the [the n-th picture element electrode and] -- the liquid crystal display according to claim 34 characterized by filling $S_{LCi}/S_{NLi}>S_{LCi+1}/S_{NLi+1}$ when it is considered as a nMIM element.

[Claim 42]The liquid crystal display according to claim 41, wherein all of area of said n non-line type resistance elements are equal.

[Claim 43]The liquid crystal display according to claim 41, wherein all of area of said n concentric picture element electrodes are equal.

[Claim 44]In a liquid crystal display which comprises two or more liquid crystal driving electrodes formed in matrix form since a liquid crystal was driven, and a switching element connected to this liquid crystal driving electrode, Said liquid crystal driving electrode is divided into the ctenidium-like first picture element electrode, and the ctenidium-like second picture element electrode, A liquid crystal display, wherein the first switching element was connected to said the ctenidium-like first picture element electrode, the second switching element was connected to said the ctenidium-like second picture element electrode and said the ctenidium-like first picture element electrode, and said the ctenidium-like second picture element electrode have got into gear mutually.

[Claim 45]The liquid crystal display according to claim 44, wherein there is said switching element by a non-line type resistance element which has the structure which laminated a conductor-insulator-conductor one by one.

[Claim 46]The liquid crystal display according to claim 45, wherein said the ctenidium-like first picture element electrode, and said the ctenidium-like second picture element electrode have got into gear mutually horizontally.

[Claim 47]The liquid crystal display according to claim 45, wherein said the ctenidium-like first picture element electrode, and said the ctenidium-like second picture element electrode have got into gear mutually perpendicularly.

[Claim 48]Area of S_{LC1}, and said the ctenidium-like second picture element electrode for area of said the ctenidium-like first picture element electrode S_{LC2}, the [in which area of a non-line type resistance element was provided by S_{NL1}, and said the ctenidium-like second picture element electrode for a start which was provided in said the ctenidium-like first picture element electrode], when area of a 2 non-line type resistance element is made into S_{NL2}, Claim 45 filling $S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$, the liquid crystal display according to claim 46 or 47.

[Claim 49]the first which has the structure in which said first switching element and said second switching element laminated a conductor-insulator-conductor one by one, respectively -- the [a non-line type resistance element and] -- a 2 non-line type resistance element being comprised, and, Capacity of a liquid crystal layer which makes each non-line type resistance element capacity C_{NL1} and C_{NL2}, and is driven with said the ctenidium-like first picture element electrode C_{LC1}, Capacity of a liquid crystal layer driven with said the ctenidium-like second picture element electrode is made into C_{LC2}, and it is $C_{LC2}/C_{NL2}=m_1\ (C_{LC1}/C_{NL1})$.

A liquid crystal display claim 45 characterized by there being the range of a value of m_1 from 0.001 to 0.999 when an upper type defines coefficient m_1 or claim 46, and given in the account of claim 47.

[Claim 50]Area of S_{LC1}, and said the ctenidium-like second picture element electrode for area of said the ctenidium-like first picture element electrode S_{LC2}, the [in which area of a non-line

type resistance element was provided by S_{NL1}, and said the ctenidium-like second picture element electrode for a start which was provided in said the ctenidium-like first picture element electrode], when area of a 2 non-line type resistance element is made into S_{NL2}, A liquid crystal display given in claim 45 claim 46 or claim 47 filling $S_{LC1}=S_{LC2}$ and $S_{NL1}<S_{NL2}$.

[Claim 51]When a ratio to area $S_{LC1}+S_{LC2}$ which set said the ctenidium-like first picture element electrode, and said the ctenidium-like second picture element electrode of said ctenidium-like first pixel electrode area S_{LC1} is made into kappa$_1$, it is kappa$_1$=$S_{LC1}/(S_{LC1}+S_{LC2})$.

The liquid crystal display according to claim 48, wherein a value of kappa$_1$ is from 0.1 to 0.9.

[Claim 52]Area of S_{LC1}, and said the ctenidium-like second picture element electrode for area of said the ctenidium-like first picture element electrode S_{LC2}, When area of a non-line type resistance element in which area of a non-line type resistance element provided in said the ctenidium-like first picture element electrode was provided by S_{NL1}, and said the ctenidium-like second picture element electrode is made into S_{NL2}, A liquid crystal display given in claim 45 claim 46 or claim 47 filling $S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$.

[Claim 53]the first which has the structure in which said first switching element and said second switching element laminated a conductor-insulator-conductor one by one, respectively -- the [a non-line type resistance element and] -- a 2 non-line type resistance element being comprised, and, Capacity of a liquid crystal layer which makes each non-line type resistance element capacity C_{NL1} and C_{NL2}, and is driven with said the ctenidium-like first picture element electrode C_{LC1}, Capacity of a liquid crystal layer driven with said the ctenidium-like second picture element electrode is made into C_{LC2}, and it is $C_{LC1}/C_{NL1}=m_2$ (C_{LC2}/C_{NL2}).

A liquid crystal display claim 45 characterized by there being the range of a value of m_2 from 0.001 to 0.999 when an upper type defines coefficient m_2 or claim 46, and given in the account of claim 47.

[Claim 54]Area of S_{LC1}, and said the ctenidium-like second picture element electrode for area of said the ctenidium-like first picture element electrode S_{LC2}, the [in which area of a non-line type resistance element was provided by S_{NL1}, and said the ctenidium-like second picture element electrode for a start which was provided in said the ctenidium-like first picture element electrode], when area of a 2 non-line type resistance element is made into S_{NL2}, Claim 45 filling $S_{LC1}=S_{LC2}$ and $S_{NL1}>S_{NL2}$, the liquid crystal display according to claim 46 or 47.

[Claim 55]When a ratio to area $S_{LC1}+S_{LC2}$ which set said the ctenidium-like first picture element electrode, and said the ctenidium-like second picture element electrode of said ctenidium-like second pixel electrode area S_{LC2} is made into kappa$_2$, it is kappa$_2$=$S_{LC2}/(S_{LC1}+S_{LC2})$.

The liquid crystal display according to claim 52, wherein a value of kappa$_2$ is from 0.1 to 0.9.

[Claim 56]For a start [characterized by comprising the following] which said liquid crystal driving electrode is divided into the first picture element electrode and the second picture element electrode, and drives said first picture element electrode in a liquid crystal display The electric non-line type characteristic of a non-line type resistance element, the [which drives said second picture element electrode] -- a liquid crystal display, wherein the electric non-line type characteristic of a 2 non-line type resistance element differs from **.

A non-line type resistance element which has the structure which laminated the 1st conductor-insulator-2nd conductor one by one.

A liquid crystal driving electrode which drives a liquid crystal.

[Claim 57]For a start [characterized by comprising the following] which said liquid crystal driving electrode is divided into the first picture element electrode and the second picture

element electrode, and drives said first picture element electrode in a liquid crystal display Thickness of an insulator layer of a non-line type resistance element, the [which drives said second picture element electrode] -- a liquid crystal display, wherein thickness of an insulator layer of a 2 non-line type resistance element differs from **.
A non-line type resistance element which has the structure which laminated the 1st conductor-insulator-2nd conductor one by one.
A liquid crystal driving electrode which drives a liquid crystal.

[Claim 58]The liquid crystal display according to claim 56 or 57 currently forming so that said second picture element electrode may enclose said first picture element electrode.
[Claim 59]said first -- the [the 1st conductor of a non-line type resistance element, and / said] -- claim 56, wherein the 1st conductor of a 2 non-line type resistance element is electrically connected in the exterior of a viewing area of a liquid crystal display -- the liquid crystal display according to claim 57 or 58.
[Claim 60]For a start [characterized by comprising the following] which said liquid crystal driving electrode is divided into the first picture element electrode and the second picture element electrode, and drives said first picture element electrode in a liquid crystal display A non-line type resistance element, said first picture element electrode and said second picture element electrode are connected in series -- as -- the -- the [a 2 non-line type resistance element and] -- a liquid crystal display providing a 3 non-line type resistance element.
A non-line type resistance element which has the structure which laminated a conductor-insulator-conductor one by one.
A liquid crystal driving electrode which drives a liquid crystal.

[Claim 61]The liquid crystal display according to any one of claims 1 to 60 taking structure in which a non-line type resistance element laminated an oxide, metal, or a transparent conducting film of metal which makes tantalum one ingredient, and metal which makes tantalum one ingredient one by one.
[Claim 62]The liquid crystal display according to any one of claims 1 to 60, wherein an insulator of a non-line type resistance element is silicon nitride.
[Claim 63]The liquid crystal display according to claim 44, wherein there is said switching element by a thin film transistor.
[Claim 64]in two or more liquid crystal driving electrodes formed in matrix form since a liquid crystal was driven, a thin film transistor connected to this liquid crystal driving electrode, and a liquid crystal display come out of and constituted, Said liquid crystal driving electrode is divided into the first picture element electrode and the second picture element electrode, The first thin film transistor is connected to said first picture element electrode, and the second thin film transistor is connected to said second picture element electrode, A liquid crystal display, wherein a gate electrode of said first thin film transistor is connected to the first scanning line, a gate electrode of said second thin film transistor is connected to the second scanning line and there are said first thin film transistor and said second thin film transistor by a reverse electric conduction type mutually.
[Claim 65]The liquid crystal display according to claim 64, wherein said first picture element electrode and said second picture element electrode have got into gear mutually by the shape of a ctenidium.
[Claim 66]The liquid crystal display according to claim 64 or 65, wherein area of area of said first picture element electrode and said second picture element electrode is equal.
[Claim 67]There is said first thin film transistor by an N type electric conduction type, and there is said second thin film transistor by a P type electric conduction type, The liquid crystal display according to claim 64, wherein area of the first picture element electrode that said first thin film transistor connected is larger than area of the second picture element electrode that said second thin film transistor connected.
[Claim 68]The liquid crystal display according to claim 67, wherein said first picture element electrode and said second picture element electrode have got into gear mutually by the shape of

a ctenidium.
[Claim 69]in two or more liquid crystal driving electrodes formed in matrix form since a liquid crystal was driven, a thin film transistor connected to this liquid crystal driving electrode, and a liquid crystal display come out of and constituted, Said liquid crystal driving electrode is divided into the first picture element electrode and the second picture element electrode, The first N type electric conduction type thin film transistor is connected to said first picture element electrode, The second P type electric conduction type thin film transistor is connected to said second picture element electrode, A gate electrode of said first thin film transistor is connected to the first scanning line, A gate electrode of said second thin film transistor is connected to the second scanning line, When channel length of said first thin film transistor was made into L_1, channel width was made into W_1, channel length of said second thin film transistor is made into L_2 and channel width is made into W_2, A liquid crystal display filling an expression of relations with $W_1/L_1<W_2/L_2$.
[Claim 70]in two or more liquid crystal driving electrodes formed in matrix form since a liquid crystal was driven, a thin film transistor connected to this liquid crystal driving electrode, and a liquid crystal display come out of and constituted, Said liquid crystal driving electrode is divided into the first picture element electrode and the second picture element electrode, The first N type electric conduction type thin film transistor is connected to said first picture element electrode, The second P type electric conduction type thin film transistor is connected to said second picture element electrode, A liquid crystal display which a gate electrode of said first thin film transistor is connected to the first scanning line, and a gate electrode of said second thin film transistor is connected to the second scanning line, and is characterized by channel length of said first thin film transistor being longer than channel length of said second thin film transistor.
[Claim 71]in two or more liquid crystal driving electrodes formed in matrix form since a liquid crystal was driven, a thin film transistor connected to this liquid crystal driving electrode, and a liquid crystal display come out of and constituted, Said liquid crystal driving electrode is divided into the first picture element electrode and the second picture element electrode, The first N type electric conduction type thin film transistor is connected to said first picture element electrode, The second P type electric conduction type thin film transistor is connected to said second picture element electrode, A liquid crystal display which a gate electrode of said first thin film transistor is connected to the first scanning line, and a gate electrode of said second thin film transistor is connected to the second scanning line, and is characterized by channel width of said first thin film transistor being narrower than channel width of said second thin film transistor.
[Claim 72]Claim 69, wherein said first picture element electrode and said second picture element electrode have got into gear mutually by the shape of a ctenidium, the liquid crystal display according to claim 70 or 71.
[Claim 73]The liquid crystal display according to any one of claims 69 to 72, wherein area of said first picture element electrode and area of said second picture element electrode are equal.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the liquid crystal display constituted including the switching element and liquid crystal driving electrodes which have the structure which laminated the conductor-insulator-conductor one by one, such as a non-line type resistance element (it is called a MIM element below) and a thin film transistor (it is called a TFT element below).
[0002]
[Description of the Prior Art]The structure of one display pixel of the liquid crystal display in which the conventional MIM element was formed is shown in drawing 2. (a) is a top view of this conventional liquid crystal display, and (b) is a sectional view. A MIM element means here the non-line type resistance element which comprises a three-tiered structure of the 1st conductor-insulator-2nd conductor, such as Ta(tantalum)-tantalic acid ghost (Ta_2O_5)-indium tin oxide (ITO), for example. In this case, as the 2nd conductor, not only ITO but the alloy which uses Cr or Cr as an ingredient, for example can be used.
[0003]Next, the manufacturing method of the liquid crystal display in which this conventional MIM element was formed is explained.
[0004]First, a Ta film is formed of a sputtering technique on the 1st substrate 201. Next, the 1st conductor 203 of MIM element 208 which this Ta film was patterned by photo etching and served as the wiring electrode is formed. And the surface of the 1st conductor 203 oxidizes with an anode oxidation method, and the insulator 204 is formed. Next, an ITO film is formed of a sputtering technique. And this ITO film is patterned by photo etching and the liquid crystal driving electrode 205 which served as the 2nd conductor of MIM element 208 is formed. The 2nd substrate 202 is formed so that it may counter with the 1st substrate 201. An ITO film is formed in the 2nd substrate 202 of a sputtering technique. And this ITO film is formed so that the wiring electrode of the 1st substrate 201 and the data line 206 patterned after stripe shape may cross at right angles by photo etching. Between the 1st substrate 201 and the 2nd substrate 202, it is filled up with the liquid crystal layer 207, and the liquid crystal display is constituted. When you need a colored presentation with this liquid crystal display, it installs a color filter layer between the 2nd substrate 202 and the data line 206 or between the data line 206 and the liquid crystal layer 207.
[0005]When a TFT element is used as a switching element, two or more data lines are formed so that it may intersect perpendicularly with two or more scanning lines and these scanning lines at the 1st substrate 201 side, and a TFT element is installed in each intersection of a scanning line and the data line. Under the present circumstances, the gate electrode of a TFT element is connected to a scanning line, a source electrode is connected to the data line and a liquid crystal driving electrode is connected to a drain electrode. The counterelectrode is provided in the 2nd substrate 202 side. Only when the potential of a selective state is given to a scanning line, it turns into the ON state of low impedance between the source drains of TFT, The potential corresponding to a status signal is given to a liquid crystal driving electrode through TFT of the data line and an ON state, and the optical states of the liquid crystal pinched

between the counterelectrode by the side of the 2nd substrate 202 and the liquid crystal driving electrode are changed. The liquid crystal driving electrode controlled by TFT is arranged at matrix form, and, thereby, presenting of information of it is attained.
[0006]
[Problem(s) to be Solved by the Invention]Now, this kind of liquid crystal display is used for a notebook sized personal computer, a workstation, liquid crystal TV, etc. in recent years, for example. Therefore, the actual condition is having also large-area-ized size of a liquid crystal display dramatically with 22.9 cm - 25.4 cm or more of vertical angles. In this actual condition, the following problems had arisen in the liquid crystal display using the conventional MIM element mentioned above.
[0007]The field intensity which impresses a scanning signal to the 1st conductor 203 that served as the wiring electrode, impresses a data signal to the ITO wiring 206, and is impressed to the liquid crystal layer 207 by time division driving is controlled by the conventional liquid crystal display, the oriented state of a liquid crystal is changed, and information is displayed. Under the present circumstances, a uniform electric field will be impressed to the liquid crystal layer inserted into the liquid crystal driving electrode 205 and the ITO wiring 206, and the problem that the visual angle characteristic of a liquid crystal display got worse had arisen. Especially, with the large area liquid crystal display of 22.9 cm - 25.4 cm or more of vertical angles, if a viewing angle is changed and a liquid crystal display is seen, the fall of contrast, reversal of intermediate color, etc. would arise and the wrong information will have been displayed.
[0008]as the art of improving such a visual angle characteristic -- SID' -- there are 91, DIGEST, P555 - 557 and SID'92, DIGEST, and conventional technology indicated to P798 - 801.
[0009]The first conventional technology (SID'91, P, 555-557) divides a liquid crystal driving electrode into two, carries out capacitive coupling of these two divided liquid crystal driving electrodes, and is driving this by one thin film transistor. As a result, the effective voltage impressed to a liquid crystal layer in 1 pixel will be two kinds, and vision characteristics improve. However, in order to carry out capacitive coupling of the two divided liquid crystal driving electrodes, the problem that structure will be complicated has arisen.
[0010]On the other hand, the second conventional technology (SID'92, P, 798-801) divides and forms the liquid crystal orientation film formed on one liquid crystal driving electrode, provides the field where the play tilt angle of a liquid crystal is large, and a small field, and raises a visual angle characteristic. However, the problem that the formation method of the orienting film of a liquid crystal becomes very complicated has arisen.
[0011]There is a technique furthermore shown in JP,5-53150,A as the 3rd conventional technology. This is explained using drawing 16. In this conventional technology, one liquid crystal driving electrode arranged at matrix form is divided into two or more picture element electrodes, a MIM element is provided in each picture element electrode, and the area and MIM element surface ratio of each picture element electrode are changed. In the example of drawing 16, the liquid crystal driving electrode and the MIM element are provided on the 1st substrate of the field appointed with the wiring 1702 provided in the counterelectrode 1701 and the 1st substrate of the stripe shape provided in the 2nd substrate.A liquid crystal driving electrode is halved by the first picture element electrode 1703 and the second picture element electrode 1704, first MIM element 1705 is connected to the first picture element electrode 1703, and second MIM element 1706 is connected to the second picture element electrode 1704. The visual angle characteristic is improved by changing the ratio of the area of the first picture element electrode, and the area of the first MIM element with the ratio of the area of the second picture element electrode, and the area of the second MIM element. However, in this third conventional technology, since no consideration was made by the split method and picture element electrode area of the liquid crystal driving electrode, the visual angle characteristic had the problem that it is not fully improved. The liquid crystal inserted into ****** and a counterelectrode reason at this rate although the consideration to the separation distance d of the first picture element electrode 1703 and the second picture element electrode 1704 was not made is not controlled, cause the fall of contrast, or, When a no Mali white display mode (method of presentation which light penetrates in the state where voltage is not impressed to a liquid crystal) performed a black

display, there was a problem that light leakage arises from an isolation region.
[0012]Without complicating structure, the place which this invention solves the above problems and is made into the purpose controls the effective voltage impressed to a liquid crystal, improves a visual angle characteristic, and there is in realizing the high liquid crystal display of display quality.
[0013]Although another purpose of this invention is shown below again, there is also in solving a technical problem at the time. That is, also when using a MIM element for a switching element, the switching element corresponding to [anyway] hundreds of thousands to millions of liquid crystal driving electrodes and it in a liquid crystal display when using a TFT element is provided. If a defect arises at least one of the switching elements which rise in these huge numbers, the switching element cannot achieve the function as a switching element, and the potential which ****s to the information which should be displayed surely will not be given to the liquid crystal driving electrode which the poor switching element connected. The liquid crystal driving electrode which the poor switching element connected as a result comes to be recognized visually as a point defect in a liquid crystal display. The technique of above-mentioned drawing 16 is known as 1 simplest conventional technology that repairs this point defect. It is a thing which this divides one liquid crystal driving electrode into two or more picture element electrodes, and provides each switching element (they are first MIM element 1705 and second MIM element 1706 at drawing 16) in each (they are the first picture element electrode 1703 and the second picture element electrode 1704 at drawing 16) picture element electrode. The almost same potential is supplied to two or more picture element electrodes divided when there were all switching elements with an excellent article, and one liquid crystal driving electrode which comprises a picture element electrode of these plurality operates normally. Even if one of two or more switching elements is poor (if first MIM element 1705 presupposes that it is poor by drawing 16), Since other switching elements of the probability which becomes poor simultaneously are dramatically small, in order that right potential may be supplied to a picture element electrode (a previous example the second picture element electrode 1704) via other normal switching elements (a previous example second MIM element 1706) which remained and one liquid crystal driving electrode may operate, It does not result in a point defect. However, a technical problem that this technique is not enough as the repair capability of a point defect occurs. For example, considering the case where it is made to operate with the no Mali white display mode with which light penetrates the liquid crystal display shown in drawing 16 when not imposing an electric field on a liquid crystal, this technical problem turns that it is clear. First MIM element 1705 presupposes that it is poor and potential is not given at all to the first picture element electrode 1703 now. If a black display is performed at this time, normal potential will be supplied to the second picture element electrode 1704 via second MIM element 1706, and the liquid crystal inserted into the second picture element electrode 1704 and the counterelectrode 1701 changes optical states correctly, and serves as a black display. An electric field will not be built over the liquid crystal inserted into the first picture element electrode 1703 that the place connected to the poor MIM element, and the counterelectrode 1701, but light will penetrate this field. When the whole screen of a liquid crystal display is indicated by black, since these picture element regions are recognized visually by the night sky like twinkling stars, there are. Although there is a situation currently assumed here by the case where a point defect is most conspicuous, it is by the reason the same technical problem arises intrinsically with a gestalt that contrast is remarkably inferior compared with the time of normal also in other display modes and element poor modes. If it puts in another way, since the conventional simple defective repair art cannot fully be repairing the defect, there is. Here, although explained using a MIM element as an example of a switching element, the completely same situation is applied also to the liquid crystal display which used the TFT element as a switching element. Then, another purpose of this invention is a thing which solves the technical problem like ****, and there is in providing the liquid crystal display which can simple and fully repair a point defect, without complicating structure and a manufacturing process.
[0014]
[Means for Solving the Problem]In order to attain said purpose, a liquid crystal display

concerning this invention, In a liquid crystal display constituted including a non-line type resistance element and a liquid crystal driving electrode which drives a liquid crystal, the first which said liquid crystal driving electrode comprises the first picture element electrode and the second picture element electrode formed in a periphery of said first picture element electrode, and drives said first picture element electrode and said second picture element electrode, respectively -- the [a non-line type resistance element and] -- it is characterized by providing a 2 non-line type resistance element. ** -- a liquid crystal display [like] -- said first -- the [a non-line type resistance element and / said] -- a 2 non-line type resistance element, When it has the structure which laminated a conductor-insulator-conductor one by one, each non-line type resistance element area is made into S_{NL1} and S_{NL2} and area of S_{LC1} and said second picture element electrode is made into S_{LC2} for area of said first picture element electrode, It is characterized by filling $S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$. or said first -- the [a non-line type resistance element and / said] -- a 2 non-line type resistance element, Have the structure which laminated a conductor-insulator-conductor one by one, and each non-line type resistance element capacity C_{NL1}. It is considered as C_{NL2}, capacity of a liquid crystal layer which drives capacity of a liquid crystal layer driven with said first picture element electrode with C_{LC1} and said second picture element electrode is made into C_{LC2}, and it is $C_{LC2}/C_{NL2}=m_1$ (C_{LC1}/C_{NL1}). When an upper type defines coefficient m_1, it is characterized by there being the range of a value of m_1 from 0.001 to 0.999. or said first -- the [a non-line type resistance element and / said] -- a 2 non-line type resistance element, When it has the structure which laminated a conductor-insulator-conductor one by one, each non-line type resistance element area is made into S_{NL1} and S_{NL2} and area of S_{LC1} and said second picture element electrode is made into S_{LC2} for area of said first picture element electrode, It is characterized by filling $S_{LC1}=S_{LC2}$ and $S_{NL1}<S_{NL2}$. When a ratio to area $S_{LC1}+S_{LC2}$ which set said first picture element electrode and said second picture element electrode of said first pixel electrode area S_{LC1} is made into $kappa_1$, it is $kappa_1=S_{LC1}/(S_{LC1}+S_{LC2})$.

It is characterized by a value of $kappa_1$ being from 0.1 to 0.9. or said first -- the [a non-line type resistance element and / said] -- a 2 non-line type resistance element, When it has the structure which laminated a conductor-insulator-conductor one by one, each non-line type resistance element area is made into S_{NL1} and S_{NL2} and area of S_{LC1} and said second picture element electrode is made into S_{LC2} for area of said first picture element electrode, It is characterized by filling $S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$. or said first -- the [a non-line type resistance element and / said] -- a 2 non-line type resistance element, Have the structure which laminated a conductor-insulator-conductor one by one, and each non-line type resistance element capacity C_{NL1}. It is considered as C_{NL2}, capacity of a liquid crystal layer which drives capacity of a liquid crystal layer driven with said first picture element electrode with C_{LC1} and said second picture element electrode is made into C_{LC2}, and it is $C_{LC1}/C_{NL1}=m_2$ (C_{LC2}/C_{NL2}). When an upper type defines coefficient m_2, it is characterized by there being the range of a value of m_2 from 0.001 to 0.999. or said first -- the [a non-line type resistance element and / said] -- a 2 non-line type resistance element, When it has the structure which laminated a conductor-insulator-conductor one by one, each non-line type resistance element area is made into S_{NL1} and S_{NL2} and area of S_{LC1} and said second picture element electrode is made into S_{LC2} for area of said first picture element electrode, It is characterized by filling $S_{LC1}=S_{LC2}$ and $S_{NL1}>S_{NL2}$. When a ratio to area $S_{LC1}+S_{LC2}$ which set the first picture element electrode and the second picture element electrode of said second pixel electrode area S_{LC2} is made into

$kappa_2$, it is $kappa_2=S_{LC2}/(S_{LC1}+S_{LC2})$.
It is characterized by a value of $kappa_2$ being from 0.1 to 0.9.
[0015]In a liquid crystal display used as two or more one liquid crystal driving electrodes of a component formed in matrix form since a liquid crystal display concerning this invention drove a liquid crystal, Each of said liquid crystal driving electrode is divided into two or more picture element electrodes, and it is characterized by the separation distance d between these picture element electrodes being 10 micrometers or less.
[0016]Two or more liquid crystal driving electrodes formed in matrix form since a liquid crystal display concerning this invention drove a liquid crystal, In a liquid crystal display constituted including a non-line type resistance element which has the structure which laminated a conductor-insulator-conductor one by one, Said liquid crystal driving electrode is divided in the direction asked for a wide viewing angle of said liquid crystal display at n picture element electrodes (integer of n>=2), When area of a non-line type resistance element which a non-line type resistance element was provided in its **** of this picture element electrode, and made ** ** and area S_{LCi} of the i-th picture element electrode (i is the arbitrary integers between 1 and n), and was provided in the i-th picture element electrode is made into S_{NLi}. It is characterized by a value of S_{LCi}/S_{NLi} of n pieces being at least two or more kinds. ** -- a liquid crystal display [like] is characterized by dividing said liquid crystal driving electrode into n picture element electrodes (integer of n>=2) to a horizontal direction of said liquid crystal display. Or it is characterized by dividing said liquid crystal driving electrode into n picture element electrodes (integer of n>=2) to a perpendicular direction of said liquid crystal display. Or said i-th value of S_{LCi}/S_{NLi} and the n+1-i-th values of $S_{LC(n+1-i)}/S_{NL(n+1-i)}$ are characterized by an equal thing. Or it is characterized by trichotomizing said liquid crystal driving electrode.
[0017]Two or more liquid crystal driving electrodes formed in matrix form since a liquid crystal display concerning this invention drove a liquid crystal, In a liquid crystal display constituted including a non-line type resistance element which has the structure which laminated a conductor-insulator-conductor one by one, It is characterized by having divided said liquid crystal driving electrode into the first picture element electrode and the second picture element electrode, and said second picture element electrode's having enclosed said first picture element electrode, and said a part of second picture element electrode having extended inside said first picture element electrode. ** -- a liquid crystal display [like] -- area of said first picture element electrode -- area of S_{LC1} and said second picture element electrode -- S_{LC2}. When area of a non-line type resistance element in which area of a non-line type resistance element provided in said first picture element electrode was provided by S_{NL1} and said second picture element electrode is made into S_{NL2}, it is characterized by filling $S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$. or said first -- the [a non-line type resistance element and / said] -- a 2 non-line type resistance element, Have the structure which laminated a conductor-insulator-conductor one by one, and each non-line type resistance element capacity C_{NL1}, It is considered as C_{NL2}, capacity of a liquid crystal layer which drives capacity of a liquid crystal layer driven with said first picture element electrode with C_{LC1} and said second picture element electrode is made into C_{LC2}, and it is $C_{LC2}/C_{NL2}=m_1 (C_{LC1}/C_{NL1})$.
When an upper type defines coefficient m_1, it is characterized by there being the range of a value of m_1 from 0.001 to 0.999. Area of S_{LC1} and said second picture element electrode for area of said first picture element electrode Or S_{LC2}, When area of a non-line type resistance element in which area of a non-line type resistance element provided in said first picture element electrode was provided by S_{NL1} and said second picture element electrode is made into S_{NL2}, it is characterized by filling $S_{LC1}=S_{LC2}$ and $S_{NL1}<S_{NL2}$. Or when a ratio to area $S_{LC1}+S_{LC2}$ which set said first picture element electrode and said second picture element electrode of said

first pixel electrode area S_{LC1} is made into $kappa_1$, it is $kappa_1=S_{LC1}/(S_{LC1}+S_{LC2})$.
It is characterized by a value of $kappa_1$ being from 0.05 to 0.8. Area of S_{LC1} and said second picture element electrode for area of said first picture element electrode Or S_{LC2}, When area of a non-line type resistance element in which area of a non-line type resistance element provided in said first picture element electrode was provided by S_{NL1} and said second picture element electrode is made into S_{NL2}, it is characterized by filling $S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$. or said first -- the [a non-line type resistance element and / said] -- a 2 non-line type resistance element, Have the structure which laminated a conductor-insulator-conductor one by one, and each non-line type resistance element capacity C_{NL1}. It is considered as C_{NL2}, capacity of a liquid crystal layer which drives capacity of a liquid crystal layer driven with said first picture element electrode with C_{LC1} and said second picture element electrode is made into C_{LC2}, and it is $C_{LC1}/C_{NL1}=m_2\ (C_{LC2}/C_{NL2})$.
When an upper type defines coefficient m_2, it is characterized by there being the range of a value of m_2 from 0.001 to 0.999. Area of S_{LC1} and said second picture element electrode for area of said first picture element electrode Or S_{LC2}, When area of a non-line type resistance element in which area of a non-line type resistance element provided in said first picture element electrode was provided by S_{NL1} and said second picture element electrode is made into S_{NL2}, it is characterized by filling $S_{LC1}=S_{LC2}$ and $S_{NL1}>S_{NL2}$. Or when a ratio to area $S_{LC1}+S_{LC2}$ which set the first picture element electrode and the second picture element electrode of said second pixel electrode area S_{LC2} is made into $kappa_2$, it is $kappa_2=S_{LC2}/(S_{LC1}+S_{LC2})$.
It is characterized by a value of $kappa_2$ being from 0.2 to 0.95.

[0018]Two or more liquid crystal driving electrodes formed in matrix form since a liquid crystal display concerning this invention drove a liquid crystal, In a liquid crystal display constituted including a non-line type resistance element which has the structure which laminated a conductor-insulator-conductor one by one, Said liquid crystal driving electrode is divided into the first picture element electrode and the second picture element electrode, It is characterized by said second picture element electrode's having enclosed said first picture element electrode, said a part of second picture element electrode's having extended inside said first picture element electrode, and also said a part of first picture element electrode having extended inside said second picture element electrode. ** -- a liquid crystal display [like] -- area of said first picture element electrode -- area of S_{LC1} and said second picture element electrode -- S_{LC2}. When area of a non-line type resistance element in which area of a non-line type resistance element provided in said first picture element electrode was provided by S_{NL1} and said second picture element electrode is made into S_{NL2}, it is characterized by filling $S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$. Area of S_{LC1} and said second picture element electrode for area of said first picture element electrode Or S_{LC2}, When area of a non-line type resistance element in which area of a non-line type resistance element provided in said first picture element electrode was provided by S_{NL1} and said second picture element electrode is made into S_{NL2}, it is characterized by filling $S_{LC1}=S_{LC2}$ and $S_{NL1}<S_{NL2}$. Area of S_{LC1} and said second picture element electrode for area of said first picture element electrode Or S_{LC2}, When area of a non-line type resistance element in which area of a non-line type resistance element provided in said first picture element electrode was provided by S_{NL1} and said second picture element electrode is made into S_{NL2}, it is characterized by filling $S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$. Area of S_{LC1} and said second picture element electrode for area of said first picture element electrode Or S_{LC2}, When area of a non-line type resistance element in which area of a non-line type resistance element provided in said first

picture element electrode was provided by S_{NL1} and said second picture element electrode is made into S_{NL2}, it is characterized by filling $S_{LC1}=S_{LC2}$ and $S_{NL1}>S_{NL2}$.

[0019]Two or more liquid crystal driving electrodes formed in matrix form since a liquid crystal display concerning this invention drove a liquid crystal, In a liquid crystal display constituted including a non-line type resistance element which has the structure which laminated a conductor-insulator-conductor one by one, said liquid crystal driving electrode is divided into n concentric picture element electrodes (integer of n>=2), and it is characterized by providing a non-line type resistance element in its **** of this concentric picture element electrode. ** -- a liquid crystal display [like] being made into area S_{LCi} of the i-th concentric picture element electrode (i is the arbitrary integers between 1 and n) of said concentric picture element electrode, and, when area of a non-line type resistance element provided in the i-th concentric picture element electrode is made into S_{NLi}, It is characterized by a value of S_{LCi}/S_{NLi} of n pieces being at least two or more kinds.

[0020]In a liquid crystal display which comprises two or more liquid crystal driving electrodes formed in matrix form since a liquid crystal display concerning this invention drove a liquid crystal, and a switching element connected to this liquid crystal driving electrode, Said liquid crystal driving electrode is divided into the ctenidium-like first picture element electrode, and the ctenidium-like second picture element electrode, The first switching element is connected to said the ctenidium-like first picture element electrode, the second switching element is connected to said the ctenidium-like second picture element electrode, and it is characterized by said the ctenidium-like first picture element electrode, and said the ctenidium-like second picture element electrode having got into gear mutually.

[0021]In a liquid crystal display which comprises two or more liquid crystal driving electrodes formed in matrix form since a liquid crystal display concerning this invention drove a liquid crystal, and a switching element connected to this liquid crystal driving electrode, Said liquid crystal driving electrode is divided into the ctenidium-like first picture element electrode, and the ctenidium-like second picture element electrode, The first switching element is connected to said the ctenidium-like first picture element electrode, and the second switching element is connected to said the ctenidium-like second picture element electrode, Said the ctenidium-like first picture element electrode, and said the ctenidium-like second picture element electrode have got into gear mutually, and it is characterized by there being said switching element by a non-line type resistance element which has the structure which laminated a conductor-insulator-conductor one by one. ** -- a liquid crystal display [like] is characterized by said the ctenidium-like first picture element electrode, and said the ctenidium-like second picture element electrode having got into gear mutually horizontally. Or it is characterized by said the ctenidium-like first picture element electrode, and said the ctenidium-like second picture element electrode having got into gear mutually perpendicularly. Area of S_{LC1}, and said the ctenidium-like second picture element electrode for area of said the ctenidium-like first picture element electrode S_{LC2}, When area of a non-line type resistance element in which area of a non-line type resistance element provided in said the ctenidium-like first picture element electrode was provided by S_{NL1}, and said the ctenidium-like second picture element electrode is made into S_{NL2}, it is characterized by filling $S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$. Area of S_{LC1}, and said the ctenidium-like second picture element electrode for area of said the ctenidium-like first picture element electrode Or S_{LC2}, When area of a non-line type resistance element in which area of a non-line type resistance element provided in said the ctenidium-like first picture element electrode was provided by S_{NL1}, and said the ctenidium-like second picture element electrode is made into S_{NL2}, it is characterized by filling $S_{LC1}=S_{LC2}$ and $S_{NL1}<S_{NL2}$. Area of S_{LC1}, and said the ctenidium-like second picture element electrode for area of said the ctenidium-like first picture element electrode Or S_{LC2}, When area of a non-line type resistance element in which area of a non-line type resistance element provided in said the ctenidium-like first picture

element electrode was provided by S_{NL1}, and said the ctenidium-like second picture element electrode is made into S_{NL2}, it is characterized by filling $S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$. Area of S_{LC1}, and said the ctenidium-like second picture element electrode for area of said the ctenidium-like first picture element electrode Or S_{LC2}, When area of a non-line type resistance element in which area of a non-line type resistance element provided in said the ctenidium-like first picture element electrode was provided by S_{NL1}, and said the ctenidium-like second picture element electrode is made into S_{NL2}, it is characterized by filling $S_{LC1}=S_{LC2}$ and $S_{NL1}>S_{NL2}$.

[0022]In a liquid crystal display which comprises two or more liquid crystal driving electrodes formed in matrix form since a liquid crystal display concerning this invention drove a liquid crystal, and a switching element connected to this liquid crystal driving electrode, Said liquid crystal driving electrode is divided into the ctenidium-like first picture element electrode, and the ctenidium-like second picture element electrode, The first switching element was connected to said the ctenidium-like first picture element electrode, the second switching element was connected to said the ctenidium-like second picture element electrode, said the ctenidium-like first picture element electrode, and said the ctenidium-like second picture element electrode have got into gear mutually, and it is characterized by there being said switching element by a thin film transistor.

[0023]In a liquid crystal display which comprises two or more liquid crystal driving electrodes formed in matrix form since a liquid crystal display concerning this invention drove a liquid crystal, and a thin film transistor connected to this liquid crystal driving electrode, Said liquid crystal driving electrode is divided into the first picture element electrode and the second picture element electrode, The first thin film transistor is connected to said first picture element electrode, and the second thin film transistor is connected to said second picture element electrode, A gate electrode of said first thin film transistor is connected to the first scanning line, a gate electrode of said second thin film transistor is connected to the second scanning line, and it is characterized by there being said first thin film transistor and said second thin film transistor by a reverse electric conduction type mutually. ** -- a liquid crystal display [like] is characterized by said first picture element electrode and said second picture element electrode having got into gear mutually by the shape of a ctenidium. Area of said first picture element electrode and area of said second picture element electrode are characterized by an equal thing.

[0024]In a liquid crystal display which comprises two or more liquid crystal driving electrodes formed in matrix form since a liquid crystal display concerning this invention drove a liquid crystal, and a thin film transistor connected to this liquid crystal driving electrode, Said liquid crystal driving electrode is divided into the first picture element electrode and the second picture element electrode,The first thin film transistor is connected to said first picture element electrode, and the second thin film transistor is connected to said second picture element electrode, A gate electrode of said first thin film transistor is connected to the first scanning line, A gate electrode of said second thin film transistor is connected to the second scanning line, There is said first thin film transistor by an N type electric conduction type, there is said second thin film transistor by a P type electric conduction type, and area of the first picture element electrode that said first thin film transistor connected is characterized by being larger than area of the second picture element electrode that said second thin film transistor connected. ** -- a liquid crystal display [like] is characterized by said first picture element electrode and said second picture element electrode having got into gear mutually by the shape of a ctenidium.

[0025]In a liquid crystal display which comprises two or more liquid crystal driving electrodes formed in matrix form since a liquid crystal display concerning this invention drove a liquid crystal, and a thin film transistor connected to this liquid crystal driving electrode, Said liquid crystal driving electrode is divided into the first picture element electrode and the second picture element electrode, The first N type electric conduction type thin film transistor is connected to said first picture element electrode, The second P type electric conduction type

thin film transistor is connected to said second picture element electrode, A gate electrode of said first thin film transistor is connected to the first scanning line, A gate electrode of said second thin film transistor is connected to the second scanning line, When channel length of said first thin film transistor was made into L_1, channel width was made into W_1, channel length of said second thin film transistor is made into L_2 and channel width is made into W_2, it is characterized by filling an expression of relations with $W_1/L_1<W_2/L_2$. ** -- a liquid crystal display [like] is characterized by said first picture element electrode and said second picture element electrode having got into gear mutually by the shape of a ctenidium. Area of said first picture element electrode and area of said second picture element electrode are characterized by an equal thing.

[0026]In a liquid crystal display which comprises two or more liquid crystal driving electrodes formed in matrix form since a liquid crystal display concerning this invention drove a liquid crystal, and a thin film transistor connected to this liquid crystal driving electrode, Said liquid crystal driving electrode is divided into the first picture element electrode and the second picture element electrode, The first N type electric conduction type thin film transistor is connected to said first picture element electrode, The second P type electric conduction type thin film transistor is connected to said second picture element electrode, A gate electrode of said first thin film transistor is connected to the first scanning line, a gate electrode of said second thin film transistor is connected to the second scanning line, and channel length of said first thin film transistor is characterized by being longer than channel length of said second thin film transistor. ** -- a liquid crystal display [like] is characterized by said first picture element electrode and said second picture element electrode having got into gear mutually by the shape of a ctenidium. Area of said first picture element electrode and area of said second picture element electrode are characterized by an equal thing.

[0027]In a liquid crystal display which comprises two or more liquid crystal driving electrodes formed in matrix form since a liquid crystal display concerning this invention drove a liquid crystal, and a thin film transistor connected to this liquid crystal driving electrode, Said liquid crystal driving electrode is divided into the first picture element electrode and the second picture element electrode, The first N type electric conduction type thin film transistor is connected to said first picture element electrode, The second P type electric conduction type thin film transistor is connected to said second picture element electrode, A gate electrode of said first thin film transistor is connected to the first scanning line, a gate electrode of said second thin film transistor is connected to the second scanning line, and channel width of said first thin film transistor is characterized by being narrower than channel width of said second thin film transistor. ** -- a liquid crystal display [like] is characterized by said first picture element electrode and said second picture element electrode having got into gear mutually by the shape of a ctenidium. Area of said first picture element electrode and area of said second picture element electrode are characterized by an equal thing.

[0028]In a liquid crystal display constituted including a non-line type resistance element which has the structure in which a liquid crystal display concerning this invention laminated the 1st conductor-insulator-2nd conductor one by one, and a liquid crystal driving electrode which drives a liquid crystal, the [which drives the electric non-line type characteristic of a non-line type resistance element, and said second picture element electrode for a start which said liquid crystal driving electrode is divided into the first picture element electrode and the second picture element electrode, and drives said first picture element electrode] -- it is characterized by the electric non-line type characteristics of a 2 non-line type resistance element differing. Or in a liquid crystal display constituted including a non-line type resistance element which has the structure in which a liquid crystal display concerning this invention laminated the 1st conductor-insulator-2nd conductor one by one, and a liquid crystal driving electrode which drives a liquid crystal, the [which drives thickness of an insulator layer of a non-line type resistance element, and said second picture element electrode for a start which said liquid crystal driving electrode is divided into the first picture element electrode and the second picture element electrode, and drives said first picture element electrode] -- it is characterized by thickness of an insulator

layer of a 2 non-line type resistance element differing. ** -- a liquid crystal display [like] -- said first -- the [the 1st conductor of a non-line type resistance element, and / said] -- it is characterized by electrically connecting the 1st conductor of a 2 non-line type resistance element in the exterior of a viewing area of a liquid crystal display. Or it is characterized by being formed so that said second picture element electrode may enclose said first picture element electrode.

[0029]In a liquid crystal display constituted including a non-line type resistance element which has the structure in which a liquid crystal display concerning this invention laminated a conductor-insulator-conductor one by one, and a liquid crystal driving electrode which drives a liquid crystal, said liquid crystal driving electrode is divided into the first picture element electrode and the second picture element electrode, and said first picture element electrode and said second picture element electrode are connected with a non-line type resistance element in series for a start which drives said first picture element electrode -- as -- the -- the [a 2 non-line type resistance element and] -- it is characterized by providing a 3 non-line type resistance element.

[0030]When, as for a liquid crystal display concerning this invention, a non-line type resistance element is used as a switching element, it is characterized by taking structure which laminated an oxide, metal, or a transparent conducting film of metal which makes tantalum one ingredient, and metal which makes tantalum one ingredient one by one.

[0031]A liquid crystal display concerning this invention is characterized by an insulator of a non-line type resistance element being silicon nitride, when a non-line type resistance element is used as a switching element.

[0032]

[Embodiment of the Invention]Although this invention is explained in detail using a drawing below, in advance of it, each claim indicates the relation of the example and drawing which are mainly concerned. However, this is the classification for only planning readers' convenience, and if a certain invention is sometimes concerned with some examples, in order to avoid a repetition of the example of the first half, it may be omitting the repetition part in the example of the second half. Therefore, the classification described below is only one rule of thumb to the last.

[0033]The invention of claims 1-10 is mainly concerned with Example 1 and drawing 1.

[0034]The invention of claims 11-15 is mainly concerned with Example 2 and drawing 3.

[0035]The invention of claims 16-24 is mainly concerned with Example 5 and drawing 8, and drawing 9.

[0036]The invention of claims 25-33 is mainly concerned with Example 6 and drawing 10.

[0037]The invention of claims 34-43 is mainly concerned with Example 7 and drawing 11.

[0038]The invention of claims 44-55 is mainly concerned with Example 8 and drawing 12, and drawing 13.

[0039]The invention of claims 56-59 is mainly concerned with Example 3 and drawing 4, and drawing 5.

[0040]The invention of claim 60 is mainly concerned with Example 4 and drawing 6, and drawing 7.

[0041]The invention of claims 63-73 is mainly concerned with Example 9 and drawing 14, and drawing 15.

[0042][Example 1] Drawing 1 shows the example by this invention, and is a sectional view [in / drawing 1 (a) can be set to a top-view figure, and / in drawing 1 (b) / AA' of drawing 1 (a)].

[0043]Ta is formed by a sputtering technique on the 1st substrate 101, such as glass, it patterns by photo etching, and the 1st conductor 103 of a MIM element is formed. The 1st conductor 103 processes the shape which served as scanning wiring, for example, the thickness makes it 1000-6000 A. Next, the surface of the 1st conductor 103 is oxidized with an anode oxidation method, and the insulator 104 of a MIM element is formed so that it may become 200-800-A thickness. For example, anodization uses platinum as the negative pole into the citrate of about 0.01 to 1% of concentration, or the solution of ammonium tartrate, it wires so that the anode may serve as the 1st conductor 103, it impresses a direct current of 10-45V, and oxidizes for 30 minutes - 4 hours. Next, the insulator 104 is calcinated at 300-500 **, the insulator 104 is used as a precise

film, and the non-line type characteristic is raised. Next, the first picture element electrode 105 and the second picture element electrode 106 of a liquid crystal driving electrode which served as the 2nd conductor of a MIM element are formed. First MIM element 111 is connected to the first picture element electrode 105, the second picture element electrode 106 is formed so that the circumference of the first picture element electrode 105 may be surrounded, and second MIM element 110 is connected. The first picture element electrode 105 and the second picture element electrode 106 form the transparent electric conductor represented by ITO (indium tin oxide) in thickness of 300-4000 A by a sputtering technique, and pattern it by photo etching. It is not necessary to form the 2nd conductor and liquid crystal driving electrode of a MIM element by one for example, and they may be formed independently, respectively, using transparent electric conductors, such as ITO, as a liquid crystal driving electrode, using metal or alloys, such as Cr, NiCrTa, Ti, as the 2nd conductor. Next, the 2nd substrate 102 is formed so that it may counter via the 1st substrate 101 and the liquid crystal layer 109. The data line 108 which processed stripe shape into the 2nd substrate 102 for transparent electric conductors, such as ITO, is formed, and it provides so that it may intersect perpendicularly with scanning wiring. Since drawing 1 was easy, explained the monochrome liquid crystal display, but. The organic layer which distributed the organic layer or paints dyed by the color Between the 2nd substrate 102 and the data lines 108, Or it can be easily considered as a color liquid crystal display by installing in the position of either between the data line 108 and the liquid crystal layer 109, between the liquid crystal driving electrodes 105 and 106 and the liquid crystal layer 109 or a between [the liquid crystal driving electrodes 105 and 106 and the 1st substrate 101].

[0044]the [the first picture element electrode 105 that the big point of difference between conventional technology and this example has by a kind of a non-line type resistance element for a start in a liquid crystal driving electrode, and] -- by dividing into two of the second picture element electrodes 106 that exist by a kind of a 2 non-line type resistance element, It is having raised the visual angle characteristic of the liquid crystal display by driving by first MIM element 111 that formed the second picture element electrode 106 in the periphery of the first picture element electrode 105, and also became independent, respectively, and second MIM element 110.

[0045]To Tech.Dig.of the Int.Electron DevicesMeeting and pp.707-710 Dec.1980, the ratio of capacity C_{MIM} of a MIM element to capacity C_{LC} of a liquid crystal layer, If C_{LC}/C_{MIM} becomes large, it is shown that the effective voltage impressed to a liquid crystal layer becomes large. The ratio of capacity C_{LC1} of the liquid crystal layer 112 to capacity C_{NL1} of first MIM element 111 driven with the first picture element electrode 105, If it is made for the ratios of capacity C_{LC2} of the liquid crystal layer 113 to capacity C_{NL2} of second MIM element 110 driven with the second picture element electrode 106 to differ, the effective voltage impressed to the liquid crystal layer 112 and the liquid crystal layer 113 will change, and a visual angle characteristic will improve.

[0046]Here the area of S_{NL1} and second MIM element 110 for the area of first MIM element 111 S_{NL2}, When specific inductive capacity of t_{NL} and the insulator 104 is made into $epsilon_{NL}$ and the dielectric constant of vacuum is made into $epsilon_O$ for the thickness of the insulator 104, C_{NL1} and C_{NL2} are $C_{NL1}=epsilon_O-epsilon_{NL}-S_{NL1}/t_{NL}$, respectively. -- (1)

$C_{NL2}=epsilon_O-epsilon_{NL}-S_{NL2}/t_{NL}$ -- (2)

It becomes. On the other hand, the area of S_{LC1} and the second picture element electrode 106 for the area of the first picture element electrode 105 S_{LC2}, When specific inductive capacity of t_{LC} and a liquid crystal is made into $epsilon_{LC}$ for the thickness of the liquid crystal layers 112 and 113, i.e., the gap of the 1st substrate 101 and the 2nd substrate 102, C_{LC1} and C_{LC2} are

$C_{LC1}=epsilon_O-epsilon_{LC}-S_{LC1}/t_{LC}$, respectively. -- (3)

$C_{LC2}=epsilon_O-epsilon_{LC}-S_{LC2}/t_{LC}$ -- (4)

It becomes.
[0047]In order to raise a visual angle characteristic as one example, it is $C_{LC1}/C_{NL1}>C_{LC2}/C_{NL2}$. -- (5)
If it is made to fill ******, the effective voltage impressed to the liquid crystal layer 112, Compared with the effective voltage impressed to the liquid crystal layer 113, it becomes large, when it sees from a transverse plane, a contrast ratio becomes large enough by the liquid crystal layer 112, and when it sees from across, a contrast ratio is compensated by the liquid crystal layer 113, and it serves as a liquid crystal display with a large angle of visibility. When especially the screen of a halftone display is seen from across, a big effect is to prevent NEGAPOJI reversal (display in white) of a screen. When formula (1) - (4) is substituted and arranged at a ceremony (5), it is $S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$. -- (6)
It turns out a next door and that the above-mentioned effect will be acquired if surface ratio is only changed. Without complicating structure and a process compared with conventional technology, since it is realizable only by changing the photo mask at the time of only patterning a liquid crystal driving electrode, there is this. In addition, since the second picture element electrode 106 has surrounded the first picture element electrode thoroughly, even if it sees a liquid crystal display given in this example from which direction, a contrast ratio is compensated with this example by the liquid crystal layer 113, and an angle of visibility becomes large by it. In this example, defective repair is possible. For example, when the insulator layer 104 of second MIM element 110 has a pinhole and the first conductor 103 and the second picture element electrode 106 have connected with it too hastily, the potential of the second picture element electrode 106 will always become the same as the potential of scanning wiring, but. Since this liquid crystal driving electrode field does not become a point defect with the first picture element electrode 105 that carries out an information display normally unless first MIM element 111 is also simultaneously poor, it is. First MIM element 111 is poor on the contrary, and even when the first picture element electrode 105 does not operate, this liquid crystal driving electrode field does not become a point defect by the normal operation of second MIM element 110 and the second picture element electrode 106. From a viewpoint with such defective repair, it is preferred that the area of the first picture element electrode 105 and the area of the second picture element electrode 106 are equal. If one [what one or] picture element electrode area was more remarkably [than the picture element electrode area of another side] large, when the MIM element linked to a large picture element electrode becomes poor, the picture element electrode linked to a normal surviving MIM element becomes remarkably small, and since defective repair is not performed effectively for the reason, it is. Time of a liquid crystal display to watch from a transverse plane in many cases is long, and the optimal contrast is doubled with a transverse plane. The liquid crystal layer 112 on the first picture element electrode 105 made the viewpoint from a transverse plane from this example, and the liquid crystal layer 113 on the second picture element electrode 106 surrounding them has compensated the upper and lower sides and the angle of visibility from a longitudinal direction with it. It is desired also from such a point for the area of the first picture element electrode 105 and the second picture element electrode 106 to be equal. In this case, about 50% of one liquid crystal driving electrode will contribute to the contrast improvement from a transverse plane, it will contribute to about 25% extending the angle of visibility of a longitudinal direction, and remaining about 25% will play the role which extends the angle of visibility of a sliding direction. Of course, the large first pixel electrode area is taken by this example, it is also possible to give priority to the contrast from a transverse plane, and it occurs. Make area of the first picture element electrode small with about 40% on the contrary, and area of the belt part which runs up and down among the second picture element electrode is made into about 20% of each right and left [about a total of 40% of], If area of the belt part which runs to right and left among the second picture element electrode is made into about 10% of about a total of 20% of each upper and lower sides, the angle of visibility of the longitudinal direction of that in which some contrast from a transverse plane is inferior will be improved remarkably. When thinking the image quality from a transverse plane as important, a comparatively large area of the first picture element electrode is taken, and since area of the

second picture element electrode is comparatively enlarged when it gives priority to an angle of visibility, it is. However, from a viewpoint that it is compatible with a wide viewing angle in high definition and also defective repair can be carried out effectively, the equal thing of first pixel electrode area S_{LC1} and second pixel electrode area S_{LC2} is preferred.

[0048]$S_{LC1}=S_{LC2}$ -- (7)

the [area S_{NL1} of the first MIM element that exists by a non-line type resistance element for a start at this time, and] -- the relation of area S_{NL2} of the second MIM element that exists by a 2 non-line type resistance element -- $S_{NL1}<S_{NL2}$-- (8)

Then, $S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$ -- (6)

****** is filled and an above-mentioned effect can be realized. (6) Where a formula is filled, when the ratio to area $S_{LC1}+S_{LC2}$ which set the first picture element electrode and the second picture element electrode of first pixel electrode area S_{LC1} is made into $kappa_1$, it is

$kappa_1=S_{LC1}/(S_{LC1}+S_{LC2})$. -- (9)

there is a value of desirable $kappa_1$ which reconciles high definition and a wide viewing angle by 0.1 to 0.9 -- more -- desirable -- 0.2 to 0.8 -- it is 0.3 to 0.7 still more preferably, and is from 0.4 to 0.6 ideally.

[0049]A view angle characteristic improves, when it is in the relation which fills the above-mentioned (5) types, or the relation which fills (6) types.

[0050]

$C_{LC2}/C_{NL2}=m_1\ (C_{LC1}/C_{NL1})$ -- (10)

When the above-mentioned (10) formula defines coefficient m_1, (5) type (6) type is $m_1<1$. -- (11)

It is described. at this time, there is the range of the value of desirable m_1 by 0.001 to 0.999 in consideration of image quality, MIM element structure, and picture element electrode structure -- more -- desirable -- 0.01 to 0.99 -- it is by 0.1 to 0.9 still more preferably, and is from 0.2 to 0.8 ideally.

[0051]When dividing a liquid crystal driving electrode into two or more picture element electrodes like this example, a role important for the separation distance d between picture element electrodes obtaining high definition is played. When the separation distance between the picture element electrodes shown in drawing 1 by d is large, since the problem called a fall and light leakage phenomenon of contrast arises, it is. The separation distance d does not produce these problems, when small enough. The almost same potential is given to the first picture element electrode 105 and the second picture element electrode 106 in the state where the liquid crystal display shows desired information, and since the liquid crystal polarization condition of the liquid crystal layer 112 and the liquid crystal layer 113 becomes almost the same, saying is in a sake. Since the coefficient of viscosity of a liquid crystal is not zero, if its separation distance d is small, the liquid crystal layer 114 on this isolation region answers in the form dragged by the liquid crystal layer 112 and the liquid crystal layer 113, and since it changes a polarization condition, there is. It is by the reason a fall or light leakage of contrast do not arise as a result. If it says a little more correctly, potential which is different in order to improve a view angle characteristic as mentioned above to the first picture element electrode 105 and the second picture element electrode 106 is given, it will **** and the polarization condition of the liquid crystal layer 112 and the liquid crystal layer 113 will serve as a different thing. If the separation distance d is small at this time, the liquid crystal layer 114 on an isolation region will change to the polarization condition of the liquid crystal layer 112, and the interim polarization condition which connects the polarization condition of the liquid crystal layer 113. If the separation distance d of a place is large, it will carry out regardless of the polarization condition of the liquid crystal layer 112, or the polarization condition of the liquid crystal layer 113, and since liquid crystal driving electrode potential will always be in the polarization condition which ****s in zero, there is the liquid crystal layer 114 on an isolation region. When there were the

place and the separation distance d which investigated the value which the viewpoint which carried out applicant claudicaton is followed and is allowed the separation distance d at 10 micrometers or less, the fall of contrast hardly became a problem, and in 7 micrometers or less, the fall of contrast was not accepted at all. In 5 more micrometers or less, light leakage when indicating by black with the no Moray white display mode was not accepted at all, either. That is, if there is the separation distance d at 10 micrometers or less, it will almost be satisfactory practically, and in 5 micrometers or less, since the liquid crystal layer 114 on an isolation region has also answered correctly, it is. Although here explained using a MIM element as a switching element, also when other switching elements, such as a TFT element, are used, of course, the same situation can be adapted and there is. Using a TFT element as a switching element, also when dividing one liquid crystal driving electrode into two or more picture element electrodes, as for the separation distance d between picture element electrodes, 10 micrometers or less are preferred, and it has 7 micrometers or less at 5 micrometers or less still more preferably more preferably.
[0052]Also when opposite to **** as other examples, it is effective and is.
[0053]$C_{LC1}/C_{NL1}<C_{LC2}/C_{NL2}$ -- (12)
Namely, $S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$ -- (13)
Then, contrary to the above, a viewing angle can be compensated by the liquid crystal layer 112, and the completely same effect as **** is acquired. When first pixel electrode area S_{LC1} and second pixel electrode area S_{LC2} are made equal, it is $S_{LC1}=S_{LC2}$. -- (7)
the [area S_{NL1} of the first MIM element that exists by a non-line type resistance element for a start, and] -- the relation of area S_{NL2} of the second MIM element that exists by a 2 non-line type resistance element -- $S_{NL1}>S_{NL2}$-- (14)
Then, the relation of (13) types is filled, and a wide viewing angle and high definition are compatible, and also defective repair also becomes possible effectively. (13) Where a formula is filled, when the ratio to area $S_{LC1}+S_{LC2}$ which set the first picture element electrode and the second picture element electrode of second pixel electrode area S_{LC2} is made into $kappa_2$, it is $kappa_2=S_{LC2}/(S_{LC1}+S_{LC2})$. -- (15)
there is a value of desirable $kappa_2$ which reconciles high definition and a wide viewing angle by 0.1 to 0.9 -- more -- desirable -- 0.2 to 0.8 -- it is 0.3 to 0.7 still more preferably, and is from 0.4 to 0.6 ideally.
[0054]A view angle characteristic improves, when it is in the relation which fills the above-mentioned (12) types, or the relation which fills (13) types.
[0055]
$C_{LC1}/C_{NL1}=m_2\ (C_{LC2}/C_{NL2})$ -- (16)
When the above-mentioned (16) formula defines coefficient m_2, (12) type (13) type is $m_2<1$. -- (17)
It is described. at this time, there is the range of the value of desirable m_2 by 0.001 to 0.999 in consideration of image quality, MIM element structure, and picture element electrode structure -- more -- desirable -- 0.01 to 0.99 -- it is by 0.1 to 0.9 still more preferably, and is from 0.2 to 0.8 ideally.
[0056]Although this example explained Ta to the example as the 1st conductor 103, The alloy which uses as an ingredient the alloy which uses Ta, such as TaMo, TaW, TaSi, and TaSiW, as an ingredient or aluminum, and aluminum can also be used, these first conductor may be oxidized by the anode oxidation method or a thermal oxidation method, and the insulator 104 may be formed. The insulator 104 may use the silicon nitride which formed membranes with a sputtering technique and plasma CVD method.
[0057][Example 2] Drawing 3 shows another example by this invention, and is a sectional view [in / drawing 3 (a) can be set to a top-view figure, and / in drawing 3 (b) / CC' of drawing 3

(a)].
[0058]On the 1st substrate 401, such as glass, the 1st conductor 403 of the MIM element which consists of metal, such as Cr, aluminum, and Mo, is formed. the 1st conductor 403 serves as the data line -- per [1 pixel area (namely, one liquid crystal driving electrode) from the data line] -- three lobes are provided. Next, the insulator 404 of a MIM element is formed with silicon nitride or a hard carbon film with a sputtering technique, plasma CVD method, etc., and three above-mentioned lobes are patterned after the wrap at least. Although it is not necessary to necessarily pattern, it is more desirable to pattern the insulator 404 by the difference between the 1st substrate 401 and the refractive index of the insulator 404, since a liquid crystal display colors. On the other hand, the 1st conductor 403 may be used as the alloy which uses Ta or Ta as an ingredient like Example 1, and the insulator 404 may be obtained with an anode oxidation method. In this case, in order only for the surface of the 1st conductor 403 to oxidize, it is not necessary to pattern the insulator 404. The silicon nitride film and the hard carbon film excel the insulator formed by anodizing the alloy which generally uses Ta or Ta as an ingredient in the non-line type characteristic. What is necessary is just to choose the material of the optimal insulator layer by the ease of such a point and the above-mentioned manufacturing method, the pixel number of a liquid crystal display, or the image quality demanded. Next, the first picture element electrode 407, the second picture element electrode 406, and the third picture element electrode 405 which served as the 2nd conductor of a MIM element are provided. As a result, first MIM element 410, second MIM element 411, and third MIM element 412 are formed in three lobes of the 1st conductor 403. The 2nd conductor and liquid crystal driving electrode of a MIM element may consist of separate materials, as Example 1 described. Next, the 2nd substrate 402 is formed in the 1st substrate 401 and the position which counters via the liquid crystal layer 409. The scanning wiring 408 which processed stripe shape into the 2nd substrate 402 for transparent electric conductors, such as ITO, is formed.
[0059]The point of difference between Example 1 and this example is a point which extended the flexibility which raises a view angle characteristic by dividing in the direction in which the wide viewing angle of a liquid crystal display is asked for one liquid crystal driving electrode at n picture element electrodes (integer of n>=2), and providing a non-line type resistance element respectively independent of each picture element electrode. In drawing 3, a liquid crystal display trichotomizes one liquid crystal driving electrode perpendicularly supposing the operating condition by which a wide viewing angle is searched for in the vertical (length or upper and lower sides) direction of a liquid crystal display screen (n= 3). The view angle characteristic of a liquid crystal display changes with application situations of each liquid crystal display. For example, in the large-sized liquid crystal display of 25 cm - about 50 cm of vertical angles applied to the display screen of a personal computer (PC) and an engineering workstation (EWS), a wide viewing angle is searched for in the vertical (length or upper and lower sides) direction of a display screen in many cases. Since the height of eyes changes with individuals also when a liquid crystal display is built into a pachinko stand, a wide viewing angle is searched for in the vertical (length or upper and lower sides) direction. Since it is assumed that there are many operating conditions which look at one liquid crystal display from the level (width or right and left) direction by two persons or three persons when adapted for the television for mount, etc. in contrast with these, a wide viewing angle is rather searched for in the level (width or right and left) direction. Since a view angle characteristic is improvable by changing the ratio of the liquid crystal capacity driven with the divided picture element electrode to each MIM element capacity for every picture element electrode so that it may mention later, it is preferred to divide one liquid crystal driving electrode in the direction asked for a wide viewing angle at two or more picture element electrodes. In the example of drawing 3, since the liquid crystal driving electrode is divided in the vertical (length or upper and lower sides) direction, while the contrast from a transverse plane is good, the angle of visibility of the vertical (length or upper and lower sides) direction becomes remarkably large. At this time, although the angle of visibility of the level (width or right and left) direction is shown in drawing 2, it is narrow like the liquid crystal display of the time former, but primarily, since the angle of visibility is not called for in that direction, it is in it. While carrying out pachinko, people gaze only at the liquid crystal display of their own

stand, and it is common that mind is taken by the liquid crystal display of the next stand, etc., and they have it. It is preferred for a liquid crystal driving electrode to be divided in ****** and the direction asked for the wide viewing angle of a liquid crystal display at n picture element electrodes (integer of n>=), to provide an MIM type non-line type resistance element in each picture element electrode, and to change the non-line type resistance element surface ratio of each picture element electrode area. It is because the wide viewing angle as a request is acquired in addition in the direction asked for a wide viewing angle where contrast from a transverse plane is made good by this. although the direction asked for a wide viewing angle may be any direction -- usually -- the level (width or right and left) direction -- or it is in the vertical (length or upper and lower sides) direction. Therefore, what is necessary is just to divide one liquid crystal driving electrode into n pieces (integer of n>=) in the vertical (length or upper and lower sides) direction, as the example of drawing 3 shows when the wide viewing angle is searched for in the vertical (length or upper and lower sides) direction. When a wide viewing angle is searched for in the level (width or right and left) direction on the contrary, 90 degrees drawing 3 a is rotated, and it is by the reason what is necessary is just to divide one liquid crystal driving electrode into n pieces (integer of n>=2) in the level (width or right and left) direction.

[0060]Next, a relation with the MIM type non-line type resistance element connected with each picture element electrode at them is explained. The capacity of first MIM element 410, second MIM element 411, and third MIM element 412, respectively C_{NL1}. The capacity of the liquid crystal layer 417 which is made into C_{NL2} and C_{NL3} and is driven with the first picture element electrode 407, the liquid crystal layer 416 driven with the second picture element electrode 406, and the liquid crystal layer 415 driven with the third picture element electrode 405, respectively C_{LC1}. It is considered as C_{LC2} and C_{LC3}, and the capacity factor of a MIM element and a liquid crystal layer is $C_{LC3}/C_{NL3}>C_{LC2}/C_{NL2}>C_{LC1}/C_{NL1}$. -- (18)

If it is made to fill ******, the visual angle characteristic of the direction of the arrow 414 can be improved substantially. All of material and thickness of the insulator 404 of first MIM element 410, second MIM element 411, and third MIM element 412 are equal, since the material and thickness of the liquid crystal layers 415, 416, and 417 are also equal -- Example 1 -- the same -- first MIM element 410, second MIM element 411, and third MIM element 412 -- each area -- S_{NL1}. Consider it as S_{NL2} and S_{NL3}, and if an upper type is replaced as S_{LC1}, S_{LC2}, and S_{LC3}, each area of the first picture element electrode 407, the second picture element electrode 406, and the third picture element electrode 405, (18) A formula is

$S_{LC3}/S_{NL3}>S_{LC2}/S_{NL2}>S_{LC1}/S_{NL1}$. -- (19)

It is come out and expressed. Therefore, in order to change the capacity factor of a MIM element and a liquid crystal layer, it is easily realizable by only changing these surface ratio.

[0061]On the other hand, the capacity factor of a MIM element and a liquid crystal layer is

$C_{LC3}/C_{NL3}<C_{LC2}/C_{NL2}<C_{LC1}/C_{NL1}$. -- (20)

Namely, $S_{LC3}/S_{NL3}<S_{LC2}/S_{NL2}<S_{LC1}/S_{NL2}$ -- (21)

If it is made to fill ******, the visual angle characteristic of arrow 413 direction can be improved.

$C_{LC3}/C_{NL3}=C_{LC1}/C_{NL1}<C_{LC2}/C_{NL2}$ -- (22)

Namely, $S_{LC3}/S_{NL3}=S_{LC1}/S_{NL1}<S_{LC2}/S_{LC2}$ -- (23)

If it is made to fill ******, the visual angle characteristic of the arrow 413 and 414 both sides can be improved symmetrically.

[0062]It is $C_{LC3}/C_{NL3}<C_{LC1}/C_{NL1}<C_{LC2}/C_{NL2}$ as a means to improve the visual angle characteristic of the arrow 413 and 414 both sides. -- (24)

Namely, $S_{LC3}/S_{NL3}<S_{LC1}/S_{NL1}<S_{LC2}/SNL2$ -- (25)

or [making it fill ******] -- or $C_{LC1}/C_{NL1}<C_{LC3}/C_{NL}$ -- $_3<C_{LC2}/C_{NL2}$-- (26)

Namely, $S_{LC1}/S_{NL1}<S_{LC3}/S_{NL3}<S_{LC2}/S_{NL2}$ -- (27)

It is realizable also by filling ******.

[0063]As for the separation distance d which separates each picture element electrode as explained in Example 1, 10 micrometers or less are preferred, and it has 7 micrometers or less at 5 micrometers or less still more preferably more preferably. This situation always suits, when dividing one liquid crystal driving electrode into two or more picture element electrodes. Some examples which divide one liquid crystal driving electrode into two or more picture element electrodes in the following examples using a TFT element and a MIM element as a switching element appear. Although reference will not be made about this separation distance d from now on in particular in those examples, all the desirable values of the separation distance d are the same as that of ****, and there are.

[0064]It can realize easily, without the flexibility which raises the visual angle characteristic of the direction desired remarkably complicating a process and structure, as explained above, When it applies to the large-sized liquid crystal display of 25 cm – about 50 cm of vertical angles especially used for the object for PC, or EWS, even if it is fixing eyes, the problem that a color tone differs from contrast by the upper and lower sides of a screen can be solved.

[0065]Although this example explained as an example the case where a liquid crystal driving electrode was trichotomized as an example, Increase the number of partitions, consider it as n division (integer of n>=4), and a non-line type resistance element is provided in its **** of these picture element electrodes, When area of the non-line type resistance element which considered it as area S_{LCi} of the i-th picture element electrode (i is the arbitrary integers between 1 and n), and was provided in the i-th picture element electrode is made into S_{NLi}, If the value of S_{LCi}/S_{NLi} of n pieces considers it as at least two or more kinds, it is clear that the flexibility of the improvement in a visual angle characteristic spreads. As (23) types explained using n= 3, the visual angle characteristic of the direction which it depends on making equal the i-th value of S_{LCi}/S_{NLi} and the n+1-i-th values of $S_{LC(n+1-i)}/S_{NL(n+1-i)}$, and is asked for the wide viewing angle can be improved symmetrically.

[0066][Example 3] Drawing 4 shows another example concerning this invention.

[0067]Shape which has one lobe per pixel, respectively is processed, and the 1st data line 501 that served as the 1st conductor of a MIM element, and the 2nd data line 502 are arranged on both the sides of the first picture element electrode 507 and the second picture element electrode 508. The second picture element electrode 508 formed behind is formed so that the first picture element electrode 507 may be enclosed around the first picture element electrode 507, and it constitutes one liquid crystal driving electrode from these first picture element electrodes 507 and the second picture element electrode 508. The 1st data line 501 and the 2nd data line 502 use the material which can anodize the alloy etc. which use as an ingredient the alloy which uses Ta, such as Ta or TaW, TaMo, TaSi, and TaSiW, as an ingredient, aluminum, or aluminum. Next, the surface of the 1st data line 501 and the 2nd data line 502 is oxidized with an anode oxidation method, and the insulator of a MIM element, the 1st becoming insulator 503, and the 2nd insulator 504 are formed. If the alloy which uses Ta or Ta as an ingredient is anodized, for example using solution, such as citrate of about 0.01 to 1% of concentration, phosphoric acid, or ammonium tartrate, a precise insulator will be obtained easily. On the other hand, the alloy used as an ingredient aluminum or aluminum The ammonium tartrate solution of about 0.01 to 5% of concentration, Or a precise insulator will be obtained, if both solutions adjust PH to 7.0-7.5 with an ammonia solution and anodize using the solution which made an ethylene glycol solvent and ammonium tartrate the solute. At this time, an insulating organic matter is formed beforehand and selection anodization is carried out so that the 1st insulator 503 or the 2nd insulator 504 may not be formed in the terminal area 511 linked to an external driver line. Or when an insulator is formed, an insulator is removed by the dry etching methods, such as reactive ion etching (RIE), using the gas of fluoridation systems, such as CF_4 and SF_6. Next, the second picture element electrode 508 is formed in the first picture element electrode 507 that served as the 2nd conductor of a MIM element, and shape which surrounds this. As a result, first MIM element 509 and second MIM element 510 are constituted by each lobe of the 1st data line

501 and the 2nd data line 502. At this time, the putt electrode 505 is simultaneously formed in the terminal area 511 so that the same data signal may be supplied to the 1st data line 501 and the 2nd data line 502. It cannot be overemphasized that the 2nd conductor and liquid crystal driving electrode of a MIM element may be formed with a separate material like Example 1. Finally, the scanning wiring 506 is formed so that it may intersect perpendicularly with the 1st data line 501 and the 2nd data line 502 via a liquid crystal layer, and a liquid crystal display is constituted.

[0068]The electric non-line type characteristic of first MIM element 509 that the point of difference between Example 1 and this example (namely, focus of this invention) drives the first picture element electrode 507, By having differed the electric non-line type characteristic of second MIM element 510 of driving the second picture element electrode 508, it is the point which extended the flexibility which raises a visual angle characteristic.

[0069]If this example is followed, when forming the 1st insulator 503 and the 2nd insulator 504 with an anode oxidation method, it becomes possible to obtain the insulator which anodizes in 2 steps and has the different non-line type characteristic. The schematic illustration at the time of anodizing to drawing 5 is shown. The 1st data line 602 and the 2nd data line 603 are formed in the 1st substrate 601 that arranges a MIM element to array form. It is connected altogether in the upper part of the 1st substrate 601, and two or more 1st data lines 602 are connected to the 1st anodization putt 605. It is altogether connected in the lower part of the 1st substrate 601 conversely [the 1st data line 602], and two or more 2nd data lines 603 are connected to the 2nd anodization putt 606. The insulator by anodization is prevented from the terminal area 604 forming an insulating organic matter, as stated above, and being formed. objects for anodization, such as an aqueous-citric-acid solution, -- transformation -- the 1st substrate 601 is immersed to the dashed line 607 into liquid, and the same -- transformation -- electrodes, such as platinum installed into liquid, are used as the negative pole, and 1st anodization is performed, for example with the impressed electromotive force of 30V by using the 1st anodization putt 605 as the anode. Next, the 2nd anodization putt 606 is used as the anode, for example, 2nd anodization is performed with the impressed electromotive force of 40V. The after-anodization dashed lines 607 and 608 cut the 1st substrate 601, and the connected data line is separated. When the thickness of the insulator formed is proportional to impressed electromotive force and also Ta is used for the 1st data line 602 and the 2nd data line 603, in order for 17-18A per 1V to form membranes, the thickness of the 1st insulator 503 will be 510-540 A, and the thickness of the 2nd insulator 504 of another side will be 680-720 A. As a result, it can be different in Example 1, not only the area of a MIM element but the thickness of an insulator can be changed, and the flexibility which changes the capacity factor of a MIM element and a liquid crystal layer can extend further.

[0070]The Poole Fraenkel current I which flows on the other hand in the tantalic acid ghost (TaO_x) obtained by anodization is I=kV exp (betarootV).

It comes out, it is expressed, and the value of beta is a coefficient showing non-linearity, and beta is in inverse proportion to the square root of thickness, if thickness of an insulator is set to d (beta**1/rootd). Therefore, by changing the thickness of an insulator, non-linearity is also changed, the non-line type characteristic of not only a capacity factor but a MIM element is changed, and it goes across the effective value of the voltage impressed to the liquid crystal layer driven with the first picture element electrode 507 and the second picture element electrode 508 broadly, and becomes controllable.

[0071]By an aqueous-citric-acid solution's performing 1st [further] anodization, and performing 2nd anodization with a phosphoric acid aqueous solution, Lynn is incorporated as an impurity into the 2nd insulator 504, and a new trap level is formed, the thickness of the 1st insulator 503 and the 2nd insulator 502 -- the same -- that is, even if it makes the same voltage impressed by the anodization which is the 1st time, and the 2nd anodization, the non-line type characteristic of first MIM element 509 and second MIM element 510 is changeable. The visual angle characteristic and contrast of a liquid crystal display can be substantially improved only by the flexibility which changes the non-line type characteristic more spreading, and increasing an

anodization process by 1 time by changing the voltage impressed to this by anodization, compared with conventional technology. The electrical property of an MIM type nonlinear resistance element may be substantially changed by changing the anodization method. a liquid crystal display given in this example -- the first anodization and anodization of a two-times eye -- impressed electromotive force and transformation -- it is possible to change oxidation conditions, such as liquid and temperature, freely and to combine them. a different MIM element produced by using the appearance controls each picture element electrode independently, and one liquid crystal driving electrode is driven. Since the image quality called contrast and angle of visibility as a result can be set up freely, it is. Of course, as this example was explained in full detail in Example 1, it is also possible to change the MIM element surface ratio of picture element electrode area, and to acquire the same effect as Example 1, and it occurs. However, structures, such as thickness of an oxide film and a presentation, are changed by changing the anodization conditions of two times by this example also in the situation which cannot be set up so that picture element electrode area and MIM element area may consider by restrictions of the restrictions on the layout of a liquid crystal driving electrode, the accuracy of photo lithography, etc., Since a wide viewing angle and high definition must have been reconciled easily, it is. In addition, even if one [what / of the 1st data line 501 or the 2nd data line 502 / one or] data line is disconnected in the liquid crystal display of this example shown in drawing 4, unless both are disconnected simultaneously, the special feature which reached to an extreme and was excellent in if a line defect does not arise is accepted. if there is nothing and it is shown in drawing 2 also until it says, but at least one open circuit arises in the data line in the liquid crystal display of conventional technology at the time, although information will not be transmitted to the point -- a reason -- a normal information display is not performed -- a field occurs in a line and what is called a line defect comes to be recognized visually Also in the liquid crystal display of this example shown in drawing 4, when an open circuit arises in the data line, the point by which information transfer is not carried out previously is the same as that of the former, and there is. However, one liquid crystal driving electrode is divided into the first picture element electrode and the second picture element electrode that encloses it in the liquid crystal display of this invention, Since it is connected to the independent data line, even if abnormalities, such as an open circuit, arise in data line of one of the two, since signal transduction is already made through data line of one of the two and the MIM element linked to it, there is a MIM element linked to each picture element electrode. In this case, since one of the two of the picture element electrode in which a previous liquid crystal driving electrode accomplishes it is dead from the open circuit, although a normal information display does not accomplish, since picture element electrode of one of the two is already operating, and it does not become a fatal line defect, it is [surviving]. make it the point defect repair explained in Example 1 -- make it the line defect repair mentioned above -- two picture element electrode shape is important for performing it effectively, and it is. Effective defective repair is clearly made for the direction divided so that the picture element electrode of another side might enclose a picture element electrode like this application in while rather than halving a liquid crystal driving electrode in parallel or right-angled with the data line simply. This is especially remarkable in the line defect repair shown in this example, and there is.

[0072][Example 4] Drawing 6 shows another example by this invention. in this example, a liquid crystal driving electrode is divided into the first picture element electrode and the second picture element electrode, and the first picture element electrode and said second picture element electrode are connected with a non-line type resistance element in series for a start which drives the first picture element electrode -- as -- the -- the [a 2 non-line type resistance element and] -- the 3 non-line type resistance element is provided.

[0073]The 1st conductor 703 of the MIM element which served as scanning wiring is processed into shape which has one lobe per pixel. As for the 1st conductor 703, it is preferred that thickness forms in about 1000-5000A with metal, such as Cr and Ta. If aluminum with lower specific resistance, Cu, etc. are preferably used in order to make delay of a scanning signal small since it serves as scanning wiring, the large-sized liquid crystal display of 25 cm or more of vertical angles is realizable. The 3rd conductor 704 is formed in island shape simultaneously with

this 1st conductor 703. Next, the insulator 705 of a MIM element is formed so that the lobe of the 1st conductor 703 and the 3rd conductor 704 may be covered at least. It is not necessary to necessarily pattern the insulator 705 like the insulator 404 shown in Example 2, and the thickness should just make it 300-3000 A using a silicon nitride film, a hard carbon film, a tantalum oxide film, etc. Next, the second picture element electrode 707 is formed in the first picture element electrode 706 that served as the 2nd conductor of a MIM element, and the shape surrounding the circumference of this first picture element electrode 706. As a result, it is formed so that second MIM element 711 and third MIM element 712 may become a portion at which first MIM element 710, the 3rd conductor 704, the first picture element electrode 706, or the second picture element electrode 707 crosses the lobe of the 1st conductor 703 with a series connection, respectively. The 2nd substrate 702 that formed the data line 708 so that it might counter via the 1st substrate 701 and the liquid crystal layer 709 is arranged. The equivalent circuit of the liquid crystal display constituted by this appearance is shown in drawing 7. First MIM element 803 equivalent to first MIM element 710 and the liquid crystal layer 806 driven with the first picture element electrode 706 are connected to the intersection of the scanning wiring 801 and the data line 802 in series. It is connected in series and first MIM element 803, second MIM element 804 that is equivalent to second MIM element 711 from the middle point of the liquid crystal layer 806, third MIM element 805 equivalent to third MIM element 712, and the liquid crystal layer 807 driven with the second picture element electrode 707 are connected to the data line 802. A scanning signal and a data signal are impressed to the scanning wiring 801 and the data line 802, respectively, first MIM element 803 is made into an ON state, an electric charge is written in the first picture element electrode 706, and a predetermined electric field is imposed on the liquid crystal layer 806. An electric charge is written also in the second picture element electrode through second MIM element 804 and third MIM element 805 simultaneously with this, and an electric field is impressed also to the liquid crystal layer 807. As a result, when the effective voltage impressed to the liquid crystal layer 806 becomes larger than the effective voltage impressed to the liquid crystal layer 807, contrast is secured by the liquid crystal layer 806 when the liquid crystal display was seen from the transverse plane, and also it sees from across, contrast is secured by the liquid crystal layer 807, and its angle of visibility improves substantially. By changing arbitrarily the area of second MIM element 711 and third MIM element 712, the effective voltage impressed to the liquid crystal layer 807 could be changed broadly, and the flexibility which improves an angle of visibility has spread. On the other hand, it is also a big advantage that second MIM element 711 and third MIM element 712 can be constituted, without increasing a process entirely.
[0074]In Example 1 - Example 4, although scanning wiring and a lengthwise direction were explained for the transverse direction as the data line to the drawing for convenience, MIM elements are 2 terminal elements, and since it is connected to a liquid crystal layer and series on the intersection of scanning wiring and the data line, it cannot be overemphasized that it is satisfactory also considering which as scanning wiring and the data line.
[0075][Example 5] Another example of this invention is explained using drawing 8. Drawing 8 shows the shape of the picture element electrode linked to the MIM element formed in the 1st substrate 101 side, and its MIM element. One liquid crystal driving electrode is divided into the first picture element electrode 905 and the second picture element electrode 906 as Example 1 explained using drawing 1 previously. First MIM element 911 that is in the first picture element electrode 905 by a non-line type resistance element for a start which has the structure which laminated the conductor-insulator-conductor one by one is connected, the [which has the structure which laminated the conductor-insulator-conductor one by one too in the second picture element electrode 906] -- second MIM element 910 that exists by a 2 non-line type resistance element is connected. An information display becomes possible by controlling the optical states of the liquid crystal layer 109 by which two or more liquid crystal driving electrodes constituted by this appearance were formed in matrix form at the 1st substrate side, and were pinched between the 2nd substrate 102 for every liquid crystal driving electrode. The situation of this neighborhood is completely the same as that of an example of an invention of the example 1 above-mentioned statement shown in drawing 1, and there is. The feature of the

invention shown in drawing 8 is at the point that the second picture element electrode 906 enclosed the first picture element electrode 905, and a part of second picture element electrode 906 has extended inside the first picture element electrode 905. It depends on carrying out like this, an improvement of the wide viewing angle characteristic and high-definition coexistence become still easier, and design flexibility also increases. In addition, since the first picture element electrode and the second picture element electrode had a relation included mutually, even if the restoration capability of a point defect compared with the invention of Example 1, in addition, it won. In other points, it is the same as that of Example 1 altogether, and is. Drawing 8 has a simple structure where the second conductor and picture element electrode of the MIM element were made to serve a double purpose. On the other hand, there is also drawing 9 in the example of 1 gestalt of this invention, and the second conductor and picture element electrode of the MIM element are formed independently here. That is, the second conductor 1016 was formed with metal or alloys, such as Cr, NiCrTa, and Ti, on the insulator of a MIM element, and this second conductor and picture element electrode have flowed through first MIM element 1011 linked to the first picture element electrode 1005. The relation between the second picture element electrode 1006, second MIM element 1010, and its second conductor 1015 is also the same, and there is. If the second conductor and picture element electrode of a MIM element are independently formed as shown in drawing 9, the electrical property of a non-line type resistance element can be changed by changing the kind of the second conductor, or element areas can be set up freely, and high definition and a wide viewing angle can be easily realized so that it may mention later. Although such a situation is not especially mentioned in other examples, it is similarly realized in the other examples.

[0076]The area of S_{NL1} and second MIM element 910-1010 for the area of first MIM element 911-1011 now S_{NL2}, When specific inductive capacity of t_{NL} and an insulator is made into epsilon$_{NL}$ and the dielectric constant of vacuum is made into epsilon$_{O}$ for the insulator film thickness of a MIM element, capacity C_{NL1} of the first MIM element and capacity C_{NL2} of the second MIM element are C_{NL1}=epsilon$_{O}$-epsilon$_{NL}$-S_{NL1}/t_{NL}, respectively. -- (1)

C_{NL2}=epsilon$_{O}$-epsilon$_{NL}$-S_{NL2}/t_{NL} -- (2)

It becomes. On the other hand, the area of S_{LC1} and the second picture element electrode 906-1006 for the area of the first picture element electrode 905-1005 S_{LC2}, The thickness of a liquid crystal layer, i.e., the gap of the 1st substrate and the 2nd substrate, t_{LC}, Liquid-crystal-capacity C_{LC1} corresponding to the first picture element electrode if specific inductive capacity of a liquid crystal is made into epsilon$_{LC}$, and liquid-crystal-capacity C_{LC2} corresponding to the second picture element electrode are C_{LC1}=epsilon$_{O}$-epsilon$_{LC}$-S_{LC1}/t_{LC}, respectively. -- (3)

C_{LC2}=epsilon$_{O}$-epsilon$_{LC}$-S_{LC2}/t_{LC} -- (4)

It becomes.

[0077]In order to raise a visual angle characteristic as one example, it is $C_{LC1}/C_{NL1}>C_{LC2}/C_{NL2}$. -- (5)

If it is made to fill ******, the contrast seen from the transverse plane will become large enough mainly with the first picture element electrode 905-1005. The second picture element electrode 906-1006 is to contribute to improving contrast when it sees from across, and to make a wide viewing angle as a result. Since a part of second picture element electrode extends even inside the first picture element electrode and it is included mutually, since it is equalized and the same contrast is acquired over a large angle, there is a view angle characteristic. Especially this becomes remarkable when the screen of a halftone display is seen from across, and a big effect is to prevent NEGAPOJI reversal (display in white) of a screen over a large angle. Like Example 1, when formula (1) - (4) is substituted and arranged at a ceremony (5), it is

$S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$. -- (6)

If it becomes and surface ratio is only changed, it turns out that the above-mentioned effect is

acquired. It can realize only by changing the photo mask at the time of patterning a liquid crystal driving electrode, without complicating structure and a process compared with conventional technology. Although the direction of the second pixel electrode area is larger than the first pixel electrode area in drawing 8 and drawing 9, the size relation between this pixel area is optimized with a basis by the kind of liquid crystal, the thickness of a liquid crystal layer, the impressed-electromotive-force range to be used, etc. As described also in the **** example 1, even if one picture element electrode of both this inventions is faulty for only improving high definition and a wide viewing angle, it also has the advantage that defective repair is automatically carried out by the pixel of another side. From a viewpoint with such defective repair, it is preferred that the area of the first picture element electrode 905-1005 and the area of the second picture element electrode 906-1006 are equal. If one [what one or] picture element electrode area was more remarkably [than the picture element electrode area of another side] large, when the MIM element linked to a large picture element electrode becomes poor, the picture element electrode linked to a normal surviving MIM element becomes remarkably small, and since defective repair is not performed effectively for the reason, it is. That is, from a viewpoint that high definition is reconciled with a wide viewing angle and also defective repair is carried out effectively, the equal thing of first pixel electrode area S_{LC1} and second pixel electrode area S_{LC2} is preferred.

[0078]$S_{LC1}=S_{LC2}$ -- (7)

the [area S_{NL1} of the first MIM element that exists by a non-line type resistance element for a start at this time, and] -- the relation of area S_{NL2} of the second MIM element that exists by a 2 non-line type resistance element -- $S_{NL1}<S_{NL2}$-- (8)

Then, $S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$ -- (6)

****** is filled and an above-mentioned effect can be realized. Although the liquid crystal driving electrode of this invention is divided into two picture element electrodes, the first picture element electrode and the second picture element electrode, Although a part of second picture element electrode that encloses the outside of the first picture element electrode has extended inside the first picture element electrode, it has threefold structure of the second picture element electrode, the first picture element electrode, and the second picture element electrode on the reason and the real target from the outside of a liquid crystal driving electrode toward the center. As a result, even if compared with the invention described in Example 1, as for this invention, the wide viewing angle is realized further. As described previously, it is preferred that the first pixel electrode area from a viewpoint and the second pixel electrode area with defective repair are equal, but. As for second pixel electrode area S_{LC2}, from the fact that it has threefold structure substantially and there are two of them with the second picture element electrode, about 2 times of first pixel electrode area S_{LC1} are preferred. When the ratio to area $S_{LC1}+S_{LC2}$ which set the first picture element electrode and the second picture element electrode of first pixel electrode area S_{LC1} like Example 1 is made into $kappa_1$, it is $kappa_1=S_{LC1}/(S_{LC1}+S_{LC2})$. -- (9)

(6) where a formula is filled, a wide viewing angle is reconciled with high definition, and also there is a value of desirable $kappa_1$ which can carry out defective repair effectively by 0.05 to 0.8 -- more -- desirable -- 0.1 to 0.7 -- it is 0.2 to 0.6 still more preferably, and be from 0.3 to 0.5 ideally.

[0079]A view angle characteristic improves, when it is in the relation which fills the above-mentioned (5) types, or the relation which fills (6) types.

[0080]

$C_{LC2}/C_{NL2}=m_1\ (C_{LC1}/C_{NL1})$ -- (10)

When the above-mentioned (10) formula defines coefficient m_1, (5) type (6) type is $m_1<1$. -- (11)

It is described. at this time, there is the range of the value of desirable m_1 by 0.001 to 0.999 in consideration of image quality, MIM element structure, and picture element electrode structure -

-- more -- desirable -- 0.01 to 0.99 -- it is by 0.1 to 0.9 still more preferably, and is from 0.2 to 0.8 ideally.

[0081]When dividing a liquid crystal driving electrode into two or more picture element electrodes like this example, a role important for the separation distance d between picture element electrodes obtaining high definition is played. About this, it is completely the same as the situation explained in full detail in the Example 1, and is. If there is the separation distance d at 10 micrometers or less, the fall of contrast will hardly become a problem and the fall of contrast will not be accepted at all in 7 micrometers or less. In 5 more micrometers or less, light leakage when indicating by black with a no Moray white display mode is not accepted at all, either.

[0082]Also when opposite to **** as other examples, it is effective and is.

[0083]$C_{LC1}/C_{NL1}<C_{LC2}/C_{NL2}$ -- (12)

Namely, $S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$ -- (13)

Since there is no change in the substantial threefold structure of a picture element electrode even if it carries out, the completely same effect as **** is acquired. When first pixel electrode area S_{LC1} and second pixel electrode area S_{LC2} are made equal, it is $S_{LC1}=S_{LC2}$. -- (7)

the [area S_{NL1} of the first MIM element that exists by a non-line type resistance element for a start, and] -- the relation of area S_{NL2} of the second MIM element that exists by a 2 non-line type resistance element -- $S_{NL1}>S_{NL2}$-- (14)

Then, the relation of (13) types is filled, and a wide viewing angle and high definition are compatible, and also defective repair also becomes possible effectively. When the ratio to area $S_{LC1}+S_{LC2}$ which set the first picture element electrode and the second picture element electrode of second pixel electrode area S_{LC2} is made into $kappa_2$, it is $kappa_2=S_{LC2}/(S_{LC1}+S_{LC2})$. -- (15)

like the above-mentioned, where (13) types are filled, a wide viewing angle is reconciled with high definition, and also there is a value of desirable $kappa_2$ which can carry out defective repair effectively by 0.2 to 0.95 -- more -- desirable -- 0.3 to 0.9 -- it is 0.4 to 0.8 still more preferably, and is from 0.5 to 0.7 ideally.

[0084]A view angle characteristic improves, when it is in the relation which fills the above-mentioned (12) types, or the relation which fills (13) types.

[0085]

$C_{LC1}/C_{NL1}=m_2\ (C_{LC2}/C_{NL2})$ -- (16)

When the above-mentioned (16) formula defines coefficient m_2, (12) type (13) type is $m_2<1$. -- (17)

It is described. at this time, there is the range of the value of desirable m_2 by 0.001 to 0.999 in consideration of image quality, MIM element structure, and picture element electrode structure -- more -- desirable -- 0.01 to 0.99 -- it is by 0.1 to 0.9 still more preferably, and is from 0.2 to 0.8 ideally.

[0086]The liquid crystal driving electrode of this invention has on parenchyma threefold structure to which two picture element electrodes are located in a line with turn with the second picture element electrode, the first picture element electrode, and the second picture element electrode sequentially from the outside. Although contrast depends mainly on the first picture element electrode 905 and 1005 when a liquid crystal display is seen from a transverse plane, and secured, the image quality recognized visually is obtained as an average of the whole liquid crystal driving electrode. an angle of visibility -- a compared point -- do image quality compensation when shallow with the first picture element electrode 905-1005 -- since it is compensated with the second picture element electrode 906-1006 when an angle of visibility is deep, it is.

[0087]The MIM type non-line type resistance element used by this example as the 1st conductor Ta and TaMo, The alloy etc. which use as an ingredient the alloy which uses Ta, such

as TaW, TaSi, and TaSiW, as an ingredient or aluminum, and aluminum are possible, it is, these first conductor is oxidized by the anode oxidation method or a thermal oxidation method in this case, and an insulator may be formed. When these alloy and other conductors are used as the 1st conductor, it is the same as that of other examples which may use the silicon nitride which the insulator formed with a sputtering technique or plasma CVD method, and there is.
[0088][Example 6] Another example of this invention is explained using drawing 10. Drawing 10 also shows the shape of the picture element electrode connected to the MIM element formed in the 1st substrate 101 side, and its MIM element like drawing 8 of Example 5. One liquid crystal driving electrode is divided into the first picture element electrode 1105 and the second picture element electrode 1106. First MIM element 1111 that is in the first picture element electrode 1105 by a non-line type resistance element for a start which has the structure which laminated the conductor-insulator-conductor one by one is connected, the [which has the structure which laminated the conductor-insulator-conductor one by one too in the second picture element electrode 1106] -- second MIM element 1110 that exists by a 2 non-line type resistance element is connected. An information display becomes possible by controlling the optical states of the liquid crystal layer 109 by which two or more liquid crystal driving electrodes constituted by this appearance were formed in matrix form at the 1st substrate side, and were pinched between the 2nd substrate 102 for every liquid crystal driving electrode. The situation of this neighborhood is completely the same as that of the above-mentioned Example 1 or an example of an invention of example 5 statement, and there is. As for the feature of this invention shown in drawing 10, the second picture element electrode 1106 enclosed the first picture element electrode 1105, a part of second picture element electrode 1106 has extended inside the first picture element electrode 1105, and also a part of first picture element electrode 1105 is at the point which has extended inside the second picture element electrode 1106. By carrying out like this, an improvement of the wide viewing angle characteristic and high-definition coexistence become still easier, and design flexibility also increases. In addition, since the first picture element electrode and the second picture element electrode had a relation which becomes entangled intricately, even if the restoration capability of a point defect compared with the invention of Example 1 or Example 5, in addition, it won. the liquid crystal driving electrode of the conventional technology represented by drawing 16 is halved simply -- **** -- since it does not pass, when there is picture element electrode of one of the two by a defective unit, it will be recognized visually there as a point defect. However, although shown in drawing 10 of drawing 8 of Example 5, drawing 9, or this example, since two picture element electrodes in which the liquid crystal driving electrode was divided at the time are entangled intricately, Even if the picture element electrode which is one side even if is faulty and there is, the light corresponding to normal information and the light corresponding to unusual information are mixed, and it is in a critical defect by the reason for not resulting. Regardless of the switching element material whether to use a MIM element for a switching element, or to use a TFT element if it puts in another way, If one liquid crystal driving electrode tends to be divided into two or more two or more picture element electrodes and you are going to make it equip the automatic restoration capability to a point defect, since light mixing arises certainly in the direction where two or more divided picture element electrodes were entangled intricately mutually and defective repair accomplishes more effectively, it is. So, since defective repair capability was excellent and drawing 8 of Example 5 won drawing 1 further rather than the conventional technology represented by drawing 16, there is an invention shown in drawing 1 of Example 1. Drawing 10 of this example has defective repair capability by a high translation further rather than drawing 8 for the same reason. This result turns that a liquid crystal display with a larger liquid crystal driving electrode is more remarkable.
[0089]next, this invention is only excellent in defective automatic restoration capability -- the point that high definition and a high view angle characteristic are also excellent too is explained. For the area of S_{NL1} and second MIM element 1110, if specific inductive capacity of t_{NL} and an insulator is made into epsilon$_{NL}$ and the dielectric constant of vacuum is made into epsilon$_{O}$ for S_{NL2} and the insulator film thickness of a MIM element, the area of now first MIM element 1111,

Capacity C_{NL1} of the first MIM element and C_{NL2} of the second MIM element are
C_{NL1}=epsilon$_O$-epsilon$_{NL}$-S_{NL1}/t_{NL}, respectively. -- (1)
C_{NL2}=epsilon$_O$-epsilon$_{NL}$-S_{NL2}/t_{NL} -- (2)
It becomes. On the other hand, the area of S_{LC1} and the second picture element electrode 1106 for the area of the first picture element electrode 1105 S_{LC2}, The thickness of a liquid crystal layer, i.e., the gap of the 1st substrate and the 2nd substrate, t_{LC}, Liquid-crystal-capacity C_{LC1} corresponding to the first picture element electrode if specific inductive capacity of a liquid crystal is made into epsilon$_{LC}$, and liquid-crystal-capacity C_{LC2} corresponding to the second picture element electrode are C_{LC1}=epsilon$_O$-epsilon$_{LC}$-S_{LC1}/t_{LC}, respectively. -- (3)
C_{LC2}=epsilon$_O$-epsilon$_{LC}$-S_{LC2}/t_{LC} -- (4)
It becomes.
[0090]In order to raise a visual angle characteristic as one example, it is $C_{LC1}/C_{NL1}>C_{LC2}/C_{NL2}$. -- (5)
If it is made to fill ******, the contrast seen from the transverse plane will become large enough mainly with the first picture element electrode 1105. The second picture element electrode 1106 is to contribute to improving contrast when it sees from across, and to make a wide viewing angle as a result. Since a part of second picture element electrode extended even inside the first picture element electrode, and also a part of first picture element electrode extended inside the second picture element electrode and it is entangled intricately mutually, a view angle characteristic turns into the result from which it is equalized and the same contrast is acquired over a large angle. Especially this becomes remarkable when the screen of a halftone display is seen from across, and even if it compares NEGAPOJI reversal (display in white) of a screen with drawing 8 of Example 5, a big effect is to prevent over a still larger angle. Like Example 1 or Example 5, when formula (1) - (4) is substituted and arranged at a ceremony (5), it is $S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$. -- (6)
If it becomes and surface ratio is only changed, it turns out that the above-mentioned effect is acquired. It can realize only by changing the photo mask at the time of patterning a liquid crystal driving electrode, without there being nothing and complicating structure and a process compared with conventional technology also in this invention also until it says. Although consideration special to the relation between the area of the first picture element electrode and the second pixel electrode area is not paid with an example of the invention shown in drawing 10, the size relation between this pixel area is optimized with a basis by the kind of liquid crystal, the thickness of a liquid crystal layer, the impressed-electromotive-force range to be used, etc. However, as described in other examples, both this inventions can also perform defective repair automatically at the same time they improve high definition and a wide viewing angle. From a viewpoint with such defective repair, it is preferred that the area of the first picture element electrode 1105 and the area of the second picture element electrode 1106 are equal too. If one [what one or] picture element electrode area was more remarkably [than the picture element electrode area of another side] large, when the MIM element linked to a large picture element electrode becomes poor, the picture element electrode linked to a normal surviving MIM element becomes remarkably small, and since defective repair is not performed effectively for the reason, it is. That is, from a viewpoint that high definition is reconciled with a wide viewing angle and also defective repair is carried out effectively, the equal thing of first pixel electrode area S_{LC1} and second pixel electrode area S_{LC2} is preferred.
[0091]$S_{LC1}=S_{LC2}$ -- (7)
the [area S_{NL1} of the first MIM element that exists by a non-line type resistance element for a start at this time, and] -- the relation of area S_{NL2} of the second MIM element that exists by a 2 non-line type resistance element -- $S_{NL1}<S_{NL2}$-- (8)

Then, $S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$ -- (6)
****** is filled and an above-mentioned effect can be realized. The liquid crystal driving electrode of this invention is divided into two picture element electrodes, the first picture element electrode and the second picture element electrode, A part of second picture element electrode that encloses the outside of the first picture element electrode has extended inside the first picture element electrode, Furthermore, although a part of first picture element electrode has extended inside the second picture element electrode, it has 4-fold structure of the second picture element electrode, the first picture element electrode, the second picture element electrode, and the first picture element electrode on the reason and the real target from the outside of a liquid crystal driving electrode toward the center. The first picture element electrode occupies a part for the duplex of the 4-fold structures, and the parts for the remaining duplex are occupied by the second picture element electrode. That is, two picture element electrodes will constitute one liquid crystal driving electrode by abbreviated halves. Since it is preferred also from a viewpoint with defective repair that the first pixel electrode area and the second pixel electrode area are equal as described previously, it is desired like Example 1 for two pixel areas to be equal. When the ratio to area $S_{LC1}+S_{LC2}$ which set the first picture element electrode and the second picture element electrode of first pixel electrode area S_{LC1} like the point is made into $kappa_1$, it is $kappa_1=S_{LC1}/(S_{LC1}+S_{LC2})$. -- (9)
a wide viewing angle is reconciled with high definition, and also there is a value of desirable $kappa_1$ which can carry out defective repair effectively by 0.1 to 0.9 -- more -- desirable -- 0.2 to 0.8 -- it is 0.3 to 0.7 still more preferably, and is from 0.4 to 0.6 ideally.
[0092]A view angle characteristic improves, when it is in the relation which fills the above-mentioned (5) types, or the relation which fills (6) types.
[0093]
$C_{LC2}/C_{NL2}=m_1\ (C_{LC1}/C_{NL1})$ -- (10)
When the above-mentioned (10) formula defines coefficient m_1, (5) type (6) type is $m_1<1$. -- (11)

It is described. at this time, there is the range of the value of desirable m_1 by 0.001 to 0.999 in consideration of image quality, MIM element structure, and picture element electrode structure -- more -- desirable -- 0.01 to 0.99 -- it is by 0.1 to 0.9 still more preferably, and is from 0.2 to 0.8 ideally.
[0094]When dividing a liquid crystal driving electrode into two or more picture element electrodes like this example, the point of playing a role important for the separation distance d between picture element electrodes obtaining high definition is the same as other examples, and there is. About this, it is completely the same as the situation explained in full detail in the Example 1, and is. If there is the separation distance d at 10 micrometers or less, the fall of contrast will hardly become a problem and the fall of contrast will not be accepted at all in 7 micrometers or less. In 5 more micrometers or less, light leakage when indicating by black with a no Moray white display mode is not accepted at all, either.
[0095]Also when opposite to **** as other one example, it is effective and is.
[0096]$C_{LC1}/C_{NL1}<C_{LC2}/C_{NL2}$ -- (12)
Namely, $S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$ -- (13)
Since there is no change in the substantial 4-fold structure of a picture element electrode even if it carries out, the completely same effect as **** is acquired. When first pixel electrode area S_{LC1} and second pixel electrode area S_{LC2} are made equal, it is $S_{LC1}=S_{LC2}$. -- (7)
the [area S_{NL1} of the first MIM element that exists by a non-line type resistance element for a start, and] -- the relation of area S_{NL2} of the second MIM element that exists by a 2 non-line type resistance element -- $S_{NL1}>S_{NL2}$-- (14)
Then, the relation of (13) types is filled, and a wide viewing angle and high definition are

compatible, and also defective repair also becomes possible effectively. When the ratio to area $S_{LC1}+S_{LC2}$ which set the first picture element electrode and the second picture element electrode of second pixel electrode area S_{LC2} is made into $kappa_2$, it is $kappa_2=S_{LC2}/(S_{LC1}+S_{LC2})$. -- (15)
like the above-mentioned, a wide viewing angle is reconciled with high definition, and also there is a value of desirable $kappa_2$ which can carry out defective repair effectively by 0.1 to 0.9 -- more -- desirable -- 0.2 to 0.8 -- it is 0.3 to 0.7 still more preferably, and is from 0.4 to 0.6 ideally.
[0097]A view angle characteristic improves, when it is in the relation which fills the above-mentioned (12) types, or the relation which fills (13) types.
[0098]
$C_{LC1}/C_{NL1}=m_2 (C_{LC2}/C_{NL2})$ -- (16)
When the above-mentioned (16) formula defines coefficient m_2, (12) type (13) type is $m_2<1$. -- (17)
It is described. at this time, there is the range of the value of desirable m_2 by 0.001 to 0.999 in consideration of image quality, MIM element structure, and picture element electrode structure -- more -- desirable -- 0.01 to 0.99 -- it is by 0.1 to 0.9 still more preferably, and is from 0.2 to 0.8 ideally.
[0099]The liquid crystal driving electrode of this invention has on parenchyma the 4-fold structure where two picture element electrodes are located in a line with turn with the second picture element electrode, the first picture element electrode, the second picture element electrode, and the first picture element electrode sequentially from the outside. When a liquid crystal display is seen from a transverse plane, contrast is secured mainly with the first picture element electrode 1105, but the image quality recognized visually is obtained as an average of the whole liquid crystal driving electrode. an angle of visibility -- a compared point -- do image quality compensation when shallow with the first picture element electrode 1105 -- since it will be compensated with the second picture element electrode 1106 if an angle of visibility becomes deep, it is. When an angle of visibility becomes still deeper, image quality compensation will be again accomplished with the first picture element electrode 1105, and the second picture element electrode 1106 will perform the second image quality compensation at the time of the deepest. As for the first picture element electrode and the second picture element electrode that encloses it, although this example has discussed as an example the picture element electrode shape shown in drawing 10, when it stands on coexistence of high definition and a high angle of visibility, and the standpoint of defective automatic restoration capability, it is preferred that it is entangled more intricately.
[0100]The MIM type non-line type resistance element used by this example as the 1st conductor Ta and TaMo, The alloy etc. which use as an ingredient the alloy which uses Ta, such as TaW, TaSi, and TaSiW, as an ingredient or aluminum, and aluminum are possible, it is, these first conductor is oxidized by the anode oxidation method or a thermal oxidation method in this case, and an insulator may be formed. When these alloy and other conductors are used as the 1st conductor, it is the same as that of other examples which may use the silicon nitride which the insulator formed with a sputtering technique or plasma CVD method, and there is.
[0101][Example 7] Another example concerning this invention is explained using drawing 11. Drawing 11 shows one liquid crystal driving electrode which comprises the concentric picture element electrode of a MIM element and plurality (the example of drawing 11 four pieces) which exists by the non-line type resistance element formed in the first substrate side. The MIM element which exists by a non-line type resistance element has the structure which laminated the conductor-insulator-conductor one by one, and one MIM element is connected to each picture element electrode. An information display becomes possible by controlling the optical states of the liquid crystal layer by which two or more such MIM elements and liquid crystal driving electrodes were formed in matrix form at the 1st substrate side, and were pinched

between the 2nd substrate for every liquid crystal driving electrode. One liquid crystal driving electrode is divided into two or more concentric picture element electrodes, and the feature of the invention shown in drawing 11 is at the point that the non-line type resistance element is provided in each concentric picture element electrode, respectively. In the example of drawing 11, one liquid crystal driving electrode is actually quadrisected sequentially from the inside with the first picture element electrode 1211, the second picture element electrode 1212, the third picture element electrode 1213, and the fourth picture element electrode 1214, First MIM element 1201, second MIM element 1202, third MIM element 1203, and fourth MIM element 1204 are connected to each picture element electrode. Although there is the division number of a liquid crystal driving electrode in the example of drawing 11 at four pieces, as long as there is this number by plurality, there may be how many. When the number of partitions is two pieces, it corresponds to the invention explained in Example 1 using drawing 1. High definition is obtained over a large angle of visibility so that it may explain later and there is much number of partitions, but if it divides into not much many concentric picture element electrodes too much, the width of each picture element electrode will become close to the separation distance d between each picture element electrode. If it falls into such a situation, since the fall of light leakage or contrast will not escape that the separation distance between picture element electrodes is small even if, it is. Therefore, the number of the maximum Oita rates of a liquid crystal driving electrode has a preferred number with which the minimum width of each picture element electrode will be about 3 or more times of separation distance. For example, when 10 micrometers and the separation distance d between picture element electrodes set to 2.5 micrometers at 150 micrometers long and 100 micrometers wide in the width (W describes in drawing 11) of a MIM element, since the size of a liquid crystal driving electrode is about 3 times of separation distance, the minimum width of each picture element electrode has it at 2.5 micrometers x about 3= 7.5 micrometers. The minimum pitch which doubled minimum picture element electrode 7.5 micrometers in width with 2.5 micrometers of separation distance is set to 10 micrometers. Therefore, in this example, the number of the maximum Oita rates will be four pieces like drawing 11. As long as such conditions are fulfilled, the fall or light leakage of contrast which originate in the isolation region between picture element electrodes by pixel division are not produced.

[0102]If the liquid crystal driving electrode is divided into two or more concentric picture element electrodes like this invention, defective repair will accomplish first very effectively. For example, even if first MIM element 1201 is poor at drawing 11 and the first picture element electrode 1211 does not perform a right information display, since this defect can be compensated with other normal MIM elements and picture element electrodes, it is. If a liquid crystal driving electrode is divided into n concentric picture element electrodes, the contribution of to each whole picture element electrode is by about 1/n. Therefore, since the gap from a normal information display when one picture element electrode becomes poor becomes small, there is, so that there is much number of partitions. In addition, the separation distance of a picture element electrode is about 1 micrometer or less, and if the maximum width of each picture element electrode is about 5 micrometers or less and there is, even if [even] one MIM element is poor and there is, the liquid crystal driving electrode containing the defective element can display right information equal to abbreviated completeness. The juniper which there is maximum width w_{max} of each picture element electrode in the example of drawing 11, and has 5 micrometers and the separation distance d at 1 micrometer. Third MIM element 1203 is poor now, and the situation where potential is not applied at all is considered to the third picture element electrode 1213. In this case, in the conventional liquid crystal display, since one MIM element is connected to one liquid crystal driving electrode, naturally it becomes a picture element defect. If w_{max} is dramatically large even if it is in this invention, the liquid crystal inserted into the third picture element electrode 1213 and the second substrate will not answer at all, and about 1/n will not be in normal optical states among the liquid crystals corresponding to this liquid crystal driving electrode. (Since the rate of the most unusual ingredient is a 1/n grade, it is by defective repair.) If the maximum width of each picture element electrode is about

5 micrometers or less and there is a place. In the case of this example, the distance between the second picture element electrode 1212 that operates normally, and the fourth picture element electrode 1214 is set to about 7 micrometers, and the almost same information will be supplied to these both picture element electrodes. Although the role which the separation distance d between picture element electrodes plays in Example 1 was explained, the liquid crystal on the third faulty picture element electrode 1213 also answers normally by the completely same principle as it, and, as a result, a right information display with this liquid crystal driving electrode equal to abbreviated completeness becomes possible. In order for such an operation to work effectively, it is needed that the maximum width of each picture element electrode is small. On the other hand, as for the separation distance between picture element electrodes, 1/3 or less [of the minimum width of a picture element electrode] is more preferred than technical problems, such as contrast and light leakage, like the above-mentioned. When an example is described and the separation distance between picture element electrodes is 1 micrometer, there is minimum picture element electrode width at not less than 3 micrometers, and there is maximum picture element electrode width at 5 micrometers or less. When the separation distance between picture element electrodes is 0.5 micrometer, at not less than 1.5 micrometers, the maximum picture element electrode width is about 6 micrometers or less, and the minimum picture element electrode width has it. It is more desirable, if not less than 2.5 micrometers and the maximum picture element electrode width shall be the minimum picture element electrode width 4 micrometers or less when separation distance is as small as 0.5 micrometer. If there is separation distance between picture element electrodes at 0.1 micrometer similarly, there is minimum picture element electrode width at 0.3 micrometers or more, and there is maximum picture element electrode width at 6.8 micrometers or less. The more the value with which it was more desirable than the point of contrast or light leakage, and the maximum picture element electrode width added the twice of separation distance to the maximum picture element electrode width the more the more it was large, when there was minimum picture element electrode width by 3 or more times of separation distance is smaller than about 7 micrometers, the more defective repair capability improves. Therefore, as separation distance is small, it is better. However, since there is a maximum of a visible light wavelength at about 0.8 micrometer, about 0.8 micrometers or more of the minimum picture element electrode width are needed too. That is, if 0.1 micrometer of separation distance between picture element electrodes becomes, the minimum picture element electrode width is [micrometers / not less than 1.5] 0.8 micrometers or more at not less than 2.5 micrometers ideally more desirable still more preferably. On the other hand, as for the maximum picture element electrode width at this time, 4.8 micrometers or less are more preferred, and it is 3.8 micrometers or less at 2.8 micrometers or less ideally desirably. When there is separation distance between picture element electrodes at 0.1 micrometer and there are both minimum picture element electrode width and maximum picture element electrode width at 2.8 micrometers, a minimum pitch is set to 3.0 micrometers and can divide one liquid crystal driving electrode into 13 to 14 concentric picture element electrodes in the example whose previous liquid crystal driving electrode width is 100 micrometers. Also from a point of the high definition later mentioned also from a point of the defective automatic repair capability mentioned above, and a simultaneous improvement of a high angle of visibility, since more ones of the number of partitions to a concentric picture element electrode are preferred, if this example is followed, a very superior liquid crystal display will be realized.

[0103]Next, a liquid crystal driving electrode is divided into n concentric picture element electrodes (integer of n>=2), When area of the non-line type resistance element which made S_{LCi} area of the i-th concentric picture element electrode (i is the arbitrary integers between 1 and n), and was provided in the concentric picture element electrode is made into S_{NLi}, If all n S_{LCi}/S_{NLi} are the same and there are not, it will explain that high definition and a high angle of visibility are obtained. As explained in full detail also in Example 1, the value of S_{LCi}/S_{NLi} of n pieces becomes equal to n $C_{LCi(s)}/C_{NLi}$, respectively. C_{LCi} is the capacity of the liquid crystal

controlled by the i-th concentric picture element electrode here, and there is C_{NLi} by the capacity of the MIM type non-line type resistance element provided in the i-th concentric picture element electrode. Therefore, if at least one values of S_{LCi}/S_{NLi} of n pieces differ, since the value of C_{LCi}/C_{NLi} of n pieces also differs in the thing corresponding to it and its view angle characteristic improves, it is. Since there is each picture element electrode with concentric [same], even if it sees a visual angle characteristic from which direction, it improves. If there are at least two or more kinds of values of S_{LCi}/S_{NLi} of n pieces theoretically, a visual angle characteristic will improve compared with a conventional example. However, it is more desirable for there to be as many kinds as possible in the value of S_{LCi}/S_{NLi} of n pieces, for acquiring a larger visual angle characteristic, and if possible, a situation where all of all of the value of n pieces differ is desired. Generally, since these values just only need to change area, they are attained easily. In the example of drawing 11, first MIM element 1201, second MIM element 1202, third MIM element 1203, and fourth MIM element 1204 have the same element areas wholly altogether. Namely, $S_{NL1}=S_{NL2}=S_{NL3}=S_{LN4}$ -- (28)
It is in ******. On the other hand, the area of each concentric picture element electrode is $S_{LC1}<S_{LC2}<S_{LC3}<S_{LC4}$. -- (29)
It carries out. therefore, surface ratio -- $S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}<S_{LC3}/S_{NL}$ -- $_3<S_{LC4}/S_{NL4}$-- (30)
All of the value of S_{LCi}/S_{NLi} of four pieces differ, and this ratio is so small that it goes to an inside concentric picture element electrode. In this case, the effective voltage impressed to the liquid crystal controlled by the fourth picture element electrode 1214 serves as the maximum, and when it sees from a transverse plane, contrast becomes settled with the fourth picture element electrode 1214. When an angle of visibility shifts from a transverse plane, an inside picture element electrode will perform contrast compensation one by one. Namely, when an angle of visibility is comparatively shallow, 1213 performs contrast compensation mainly to the third picture element electrode. If an angle of visibility becomes large rather than it, the picture element electrode which mainly performs contrast compensation will move to the second picture element electrode 1212, and when an angle of visibility becomes still larger, the first picture element electrode 1211 will mainly take charge of contrast compensation. a ratio with the MIM type non-line type resistance element area linked to each picture element electrode area divided as this example showed, and its picture element electrode -- the angle of visibility from which it is larger for all S_{LCi}/S_{NLi} to differ is obtained. As for the change condition of this ratio, it is preferred to change from the outside in monotone toward the inside, as this example shows. Namely, use as the first picture element electrode the picture element electrode located in the innermost part, and the MIM type non-line type resistance element linked to it is named the first MIM element, the picture element electrode and MIM type non-line type resistance element which set to the second and the third as it progresses outside one by one below, and are located in the outermost part -- respectively -- the [the n-th picture element electrode and] -- the time of considering it as a nMIM element -- S_{LCi}/S_{NLi} -- $<S_{LCi+1}/S_{NLi+1}$-- (31)
** and $S_{LCi}/S_{NLi}>S_{LCi+1}/S_{NLi+1}$-- (32)
Having become is preferred. However, there is i for the arbitrary integers between 1 and n-1 here. (31) If 1, 2, and 3 are substituted for i of a formula, the relation of (30) types shown in the previous example will be obtained, and the value of S_{LCi}/S_{NLi} becomes so small that it goes inside. In the case of (32), S_{LCi}/S_{NLi} becomes so small that it goes outside on the contrary. In this case, contrast compensation from a transverse plane is performed by the first picture element electrode located in the innermost part, When a viewing angle becomes deep, contrast compensation is taken charge of with an outside picture element electrode one by one, and when a viewing angle becomes deep most, contrast is compensated with the n-th picture element electrode located in the outermost part. Such a relation is obtained by adjusting the width of

each picture element electrode, or adjusting the second conductor area of a MIM element part etc. .It is $S_{NLi}=S_{NLi+1}$ as the example of drawing 11 shows. -- (33)
(i is $S_{LCi}<S_{LCi+1}$ if arbitrary integer) between 1 and n-1 and all the non-line type resistance element area are equal. -- (34)
It is alike, (31) types are filled more, and it is $S_{LCi}>S_{LCi+1}$. -- (35)
It comes out and (32) types are filled. (34) and (35) -- any formula is as having explained previously and has that high definition and a wide viewing angle are acquired. Thus, all element areas are made equal, and when changing picture element electrode area and acquiring a wide viewing angle, the automatic largest picture element electrode will have a value of the greatest S_{LCi}/S_{NLi}. That is, when it is in the relation which fills (34) types, n-th pixel electrode area S_{LCn} located in the outermost part is the maximum, and as a result, S_{LCn}/S_{NLn} becomes the maximum among the values of S_{LCi}/S_{NLi} of n pieces. When it is in the relation which fills (35) types similarly, first pixel electrode area S_{LC1} located in the innermost part is the maximum, and inner $S_{LC1}/S_{NL1}$of n $S_{LCi(s)}/S_{NLi}$ becomes the maximum. Since the contrast from a transverse plane is acquired with the greatest thing in n $S_{LCi(s)}/S_{NLi}$, the largest concentric picture element electrode will secure the pixel from a transverse plane. Although high definition and a wide viewing angle are easily compatible by this invention, when thinking the image quality from a transverse plane as important also especially among them, since high definition is certainly obtained in the state with most operating conditions by filling (33) - (35) to this appearance, it is.

[0104]Although it is equal, and MIM element area changed picture element electrode area and has acquired high definition and a wide viewing angle so far, of course, the reverse is also possible and occurs. That is, each picture element electrode area is made equal, and since MIM element area is changed, it is. It is $S_{LCi}=S_{LCi+1}$, when one liquid crystal driving electrode is divided into n concentric picture element electrodes and the n-th number is defined from No. 1 toward the inside to the outside like the point. -- (36)
It is alike and all the picture element electrode area becomes equal more. However, there is i for the arbitrary integers between 1 and n-1 also here. Furthermore, it is $S_{NLi}>S_{NLi+1}$. -- (37)
Then, the expression of relations of (31) is obtained and it is $S_{NLi}<S_{NLi+1}$. -- (38)
Then, the expression of relations of (32) is obtained. (37) the [to which it is the maximum, the more nearly outside MIM element becomes small below, and the area of the first MIM element to which a formula is located in the innermost part is located in the outermost part] -- the area of the nMIM element serves as the minimum. (38) The formula expresses this thing whose inside MIM element it is opposite and is smaller than an outside MIM element. As for the liquid crystal display which changed this MIM element area and made all picture element electrode area equal, a view angle characteristic is improved remarkably. Since the picture element electrode which the minimum MIM element connected secures the image quality from a transverse plane and contrast when the picture element electrode which the maximum MIM element connected has the deepest angle of visibility is secured, it is. It means that the image quality from a transverse plane of the image quality from ******** is also equivalent, and it has it namely that all of all of such picture element electrode area are equal. Therefore, especially the liquid crystal display that fills related (36) - (38) explained here is the best for the device for which a wide viewing angle is needed, and there is. This liquid crystal display is simultaneously provided with effective automatic making-good capability. Since each picture element electrode area of all is equal, even if which one picture element electrode is faulty and there is, although the gap from normal information always turns into 1/n, there is by a reason.
[0105]carry out, when MIM element area is equal and picture element electrode area differs -- when picture element electrode area is equal and MIM element area differs, carry out. or like (31) types, when surface ratio (S_{LCi}/S_{NLi} will be called surface ratio from now on.) is as small as the

inside, carry out -- conversely like (32) types, when as small as the outside, carry out -- as for surface ratio, it is preferred to change from the inside in monotone toward the outside. The contrast characteristic of a liquid crystal display changes continuously in monotone as an angle of visibility becomes deep and goes. So, since image quality security will be performed by automatically smooth sensibility if the concentric picture element electrode which mainly performs the contrast compensation also performs change continuous in monotone, it is. In the meaning, as there is much division number to n concentric picture element electrodes of one liquid crystal driving electrode, it is better. Although the concentric picture element electrode which will mainly perform contrast compensation if there is little division number shows a step form discontinuous change, if there is much division number, since a continuous change will be approached and it will go change, there is. If there is dramatically much division number n, it will become possible to provide each surface ratio in an abbreviated continuation target so that it may agree in the view angle dependence of the contrast which changes continuously, and it also becomes possible to erase the view angle dependence of contrast. In order to acquire high definition and a wide viewing angle more certainly, the division number n is enlarged as much as possible, and since it is important to turn surface ratio outside and to change it from the inside in monotone, it is.
[0106]The MIM type non-line type resistance element used by this example as the 1st conductor Ta and TaMo, The alloy etc. which use as an ingredient the alloy which uses Ta, such as TaW, TaSi, and TaSiW, as an ingredient or aluminum, and aluminum are possible, it is, these first conductor is oxidized by the anode oxidation method or a thermal oxidation method in this case, and an insulator may be formed. When these alloy and other conductors are used as the 1st conductor, it is the same as that of other examples which may use the silicon nitride which the insulator formed with a sputtering technique or plasma CVD method, and there is.
[0107][Example 8] Another example of this invention is explained using drawing 12 and drawing 13. Drawing 12 and drawing 13 show the shape of the picture element electrode linked to the switching element formed in the 1st substrate side, and its switching element. The liquid crystal display of this invention comprises two or more liquid crystal driving electrodes formed in the first substrate side at matrix form since a liquid crystal was driven, and a switching element connected to this liquid crystal driving electrode. One liquid crystal driving electrode is divided into the ctenidium-like first picture element electrode, and the ctenidium-like second picture element electrode, the first switching element is connected to the ctenidium-like first picture element electrode, and the second switching element is connected to the ctenidium-like second picture element electrode. Since the ctenidium-like first picture element electrode, and the ctenidium-like second picture element electrode have got into gear mutually, there are. Although the MIM type non-line type resistance element is used as a switching element in this example, since the first feature of this invention is in such picture element electrode shape, as a switching element, other switching elements, such as a TFT element, are possible, and it has them. At drawing 12, the ctenidium-like first picture element electrode, and the ctenidium-like second picture element electrode have got into gear mutually horizontally, and the ctenidium-like first picture element electrode, and the ctenidium-like second picture element electrode have got into gear mutually perpendicularly by drawing 13. As Example 2 explained using drawing 3, when a high angle of visibility is called for in the vertical (upper-and-lower-sides or length) direction of a liquid crystal display screen, as shown in drawing 12, two ctenidium-like picture element electrodes are engaged horizontally. When a high angle of visibility is called for in the level (right-and-left or width) direction of a liquid crystal display screen on the contrary, as shown in drawing 13, two ctenidium-like picture element electrodes are engaged perpendicularly. One liquid crystal driving electrode is divided into the ctenidium-like first picture element electrode 1311, 1331, 1411, and 1431, and the ctenidium-like second picture element electrode 1312, 1332, 1412, and 1432. The non-line type resistance element (the first MIM element) 1301 is connected for a start which is in the ctenidium-like first picture element electrode 1311 by the first switching element that has the structure which laminated the conductor-insulator-conductor one by one, the [which is in the ctenidium-like second picture element electrode 1312 by the second switching element that has the structure which laminated the conductor-insulator-conductor one by one

too] -- the 2 non-line type resistance element (the second MIM element) 1302 is connected. First MIM element 1321 is connected to the ctenidium-like first picture element electrode 1331 like the following, and second MIM element 1322 is connected to the ctenidium-like second picture element electrode 1332. First MIM element 1401 is connected to the ctenidium-like first picture element electrode 1411, and second MIM element 1402 is connected to the ctenidium-like second picture element electrode 1412. Since first MIM element 1421 is connected to the ctenidium-like first picture element electrode 1431 and second MIM element 1422 is connected to the ctenidium-like second picture element electrode 1432, it is. An information display becomes possible by controlling the optical states of the liquid crystal layer by which two or more liquid crystal driving electrodes constituted by this appearance were formed in matrix form at the 1st substrate side, and were pinched between the 2nd substrate for every liquid crystal driving electrode. The situation of this neighborhood is completely the same as that of an example of an invention of the example 1 above-mentioned statement shown in drawing 1, and there is. The ctenidium-like first picture element electrode, and the ctenidium-like second picture element electrode get into gear mutually, and the feature of the invention shown in drawing 12 and drawing 13 constitutes one liquid crystal driving electrode, and is at the point that the switching element independent of each picture element electrode is provided. Thereby, automatic restoration of a point defect is performed effectively. It is better for two divided picture element electrodes to be entangled intricately mutually, when dividing one liquid crystal driving electrode into two picture element electrodes and making defective automatic restoration capability equip as Example 6 explained using drawing 10. Since the light which passed two picture element electrodes by this is mixed, it is. For example, when it is going to indicate by black with a no Moray white display mode now, one switching element is poor and considers the situation which does not require the potential corresponding to a black display to the switching element. In the conventional liquid crystal display shown in drawing 16, since light mixing did not arise at all, the liquid crystal on the picture element electrode linked to a defective element penetrated light straightly, and had become a small bright point defect of the grade as a matter of fact. However, in this invention, since light mixing arises, the black corresponding to the white corresponding to a defective pixel and a normal pixel is mixed, and it becomes middle gray. Of course, since the information which should be displayed correctly is black in the present example, it means that the gray display shows defective information strictly. However, when using a liquid crystal display, there is a great difference by a small bright point defect and gray display. Since a bright point defect is very conspicuous, since it is not usually found unless it is considerably careful of a fatal, but gray defect and sees it, there is. That is, it reaches to an extreme of this invention, and it is performing defective automatic repair effectively. The minimum width of the concentric picture element electrode which the width w of the ctenidium of a ctenidium-like picture element electrode, the relation of the separation distance d between picture element electrodes, and a number (two ctenidiums have geared in the example of drawing 12 and drawing 13, respectively.) of a ctenidium of relations that have geared mutually explained using drawing 11 in Example 7. It is equal to the relation between maximum width w_{max}, the separation distance d between picture element electrodes, and the division number of a picture element electrode. That is, in order not to cause the fall of light leakage or contrast, 3 or more times of the separation distance d between picture element electrodes are required for the minimum width of a ctenidium, and it is. Like the point, if there is the separation distance d between picture element electrodes at 10 micrometers or less, the fall of contrast will hardly become a problem and the fall of contrast will not be accepted at all at 7 micrometers or less. Private seals become that light leakage when indicating by black with a no Moray white display mode in 5 more micrometers or less does not have less, either. Even if the MIM element which the separation distance between picture element electrodes will be about 1 micrometer or less, and will be one side even if if the maximum width of each ctenidium is about 5 micrometers or less and there is is poor and there is, the liquid crystal driving electrode which depends on the ctenidium-like picture element electrode linked to the MIM element and ** of another side, and contains the defective element can display right information equal to abbreviated completeness.

The situation of this neighborhood is the same as Example 7, and there is. That is, as an example, when the separation distance between picture element electrodes shall be 1 micrometer, there is minimum width of a ctenidium at not less than 3 micrometers, and there is the maximum width at 5 micrometers or less. Or when the separation distance between picture element electrodes is 0.5 micrometer, at not less than 1.5 micrometers, the maximum width is about 5 micrometers or less of ****, and the minimum width of a ctenidium has it. It is more desirable, if the minimum width of a ctenidium shall be not less than 1.5 micrometers and the maximum electrode width shall be 4 micrometers or less, when separation distance is as small as 0.5 micrometer. If there is separation distance between picture element electrodes at 0.1 micrometer similarly, there is minimum width at 0.3 micrometers or more, and there is the maximum width at 3.8 micrometers or less. The more the value with which it was more desirable than the point of contrast or light leakage, and the maximum width added the twice of separation distance to the maximum width the more the more it was large, when there was minimum width of a ctenidium by 3 or more times of separation distance is smaller than about 7 micrometers, the more defective repair capability improves. Therefore, as separation distance is small, it is better. Since there is a maximum of a visible light wavelength at about 0.8 micrometer as stated also in advance, about 0.8 micrometers or more of the minimum picture element electrode width are needed too. If 0.1 micrometer of separation distance between picture element electrodes becomes after all, the minimum width of a ctenidium is [micrometers / not less than 1.5] 0.8 micrometers or more at not less than 2.5 micrometers ideally more desirable still more preferably. On the other hand, as for the maximum width at this time, 4.8 micrometers or less are more preferred, and it is 3.8 micrometers or less at 2.8 micrometers or less ideally desirably.
[0108]By carrying out like this, an improvement of the wide viewing angle characteristic and high-definition coexistence become easier, and design flexibility also increases. In addition, since it changed with the structure where the first picture element electrode and the second picture element electrode have got into gear by turns mutually, even if the restoration capability of a point defect compared with the invention of Example 1, in addition, it won.
[0109]now, this -- until -- an argument -- the same -- the area of first MIM element 1301-1321, 1401, and 1421 -- S_{NL1}. If specific inductive capacity of t_{NL} and an insulator is made into epsilon_{NL} and the dielectric constant of vacuum is made into epsilon_{O} for S_{NL2} and the insulator film thickness of a MIM element, the area of second MIM element 1302-1322, 1402, and 1422, Capacity C_{NL1} of the first MIM element and capacity C_{NL2} of the second MIM element are
$C_{NL1}=\text{epsilon}_{O}-\text{epsilon}_{NL}-S_{NL1}/t_{NL}$, respectively. -- (1)
$C_{NL2}=\text{epsilon}_{O}-\text{epsilon}_{NL}-S_{NL2}/t_{NL}$ -- (2)
It becomes. On the other hand, the area of the ctenidium-like first picture element electrode 1311-1331, 1411, and 1431 S_{LC1}. The area of the ctenidium-like second picture element electrode 1312-1332, 1412, and 1432 S_{LC2}. The thickness of a liquid crystal layer, i.e., the gap of the 1st substrate and the 2nd substrate, t_{LC}. Liquid-crystal-capacity C_{LC1} corresponding to the ctenidium-like first picture element electrode if specific inductive capacity of a liquid crystal is made into epsilon_{LC}, and liquid-crystal-capacity C_{LC2} corresponding to the ctenidium-like second picture element electrode are $C_{LC1}=\text{epsilon}_{O}-\text{epsilon}_{LC}-S_{LC1}/t_{LC}$, respectively. -- (3)
$C_{LC2}=\text{epsilon}_{O}-\text{epsilon}_{LC}-S_{LC2}/t_{LC}$ -- (4)
It becomes.
[0110]In order to raise a visual angle characteristic as an example, it is $C_{LC1}/C_{NL1}>C_{LC2}/C_{NL2}$. -- (5)
If it is made to fill ******, the contrast seen from the transverse plane will become large enough mainly with the ctenidium-like first picture element electrode 1311-1331, 1411, and 1431. The ctenidium-like second picture element electrode 1312-1332, 1412, and 1432 is to contribute to improving contrast when it sees from across, and to make a wide viewing angle as a result. Since a view angle characteristic is equalized since two ctenidium-like picture element electrodes have

got into gear mutually, and the same contrast is acquired over a large angle, it is. Especially this becomes remarkable when the screen of a halftone display is seen from across, and a big effect is to prevent NEGAPOJI reversal (display in white) of a screen over a large angle. Like Example 1, when formula (1) - (4) is substituted and arranged at a ceremony (5), it is
$S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$. -- (6)
If it becomes and surface ratio is only changed, it turns out that the above-mentioned effect is acquired. It can realize only by changing the photo mask at the time of patterning a liquid crystal driving electrode, without complicating structure and a process compared with conventional technology. As described also in the Example 1, even if one picture element electrode of both this inventions is faulty for only improving high definition and a wide viewing angle, it also has the advantage that defective repair is automatically carried out by the pixel of another side. From a viewpoint with such defective repair, it is preferred that the area of the ctenidium-like first picture element electrode 1311-1331, 1411, and 1431 and the area of the ctenidium-like second picture element electrode 1312-1332, 1412, and 1432 are equal. If one [what one or] picture element electrode area was more remarkably [than the picture element electrode area of another side] large, when the MIM element linked to a large picture element electrode becomes poor, the picture element electrode linked to a normal surviving MIM element becomes remarkably small, and since defective repair is not performed effectively for the reason, it is. That is, from a viewpoint that high definition is reconciled with a wide viewing angle and also defective repair is carried out effectively, the equal thing of ctenidium-like first pixel electrode area S_{LC1} and ctenidium-like second pixel electrode area S_{LC2} is preferred.
[0111]$S_{LC1}=S_{LC2}$ -- (7)
the [area S_{NL1} of the first MIM element that exists by a non-line type resistance element for a start at this time, and] -- the relation of area S_{NL2} of the second MIM element that exists by a 2 non-line type resistance element -- $S_{NL1}<S_{NL2}$-- (8)
Then, $S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$ -- (6)
****** is filled and an above-mentioned effect can be realized. When both MIM element area and ctenidium-like picture element electrode area are optimized, When the ratio to area $S_{LC1}+S_{LC2}$ which set the ctenidium-like first picture element electrode, and the ctenidium-like second picture element electrode of ctenidium-like first pixel electrode area S_{LC1} is made into kappa$_1$, it is kappa$_1$=$S_{LC1}/(S_{LC1}+S_{LC2})$. -- (9)
a wide viewing angle is reconciled with high definition, and also there is a value of desirable kappa$_1$ which can carry out defective repair effectively by 0.1 to 0.9 -- more -- desirable -- 0.2 to 0.8 -- it is 0.3 to 0.7 still more preferably, and is from 0.4 to 0.6 ideally.
[0112]A view angle characteristic improves, when it is in the relation which fills the above-mentioned (5) types, or the relation which fills (6) types.
[0113]
$C_{LC2}/C_{NL2}=m_1(C_{LC1}/C_{NL1})$ -- (10)
if the above-mentioned (10) formula defines coefficient m_1 -- (5) type (6) type -- $m_1<1$ -- (11)
It is described. at this time, there is the range of the value of desirable m_1 by 0.001 to 0.999 in consideration of image quality, MIM element structure, and picture element electrode structure -- more -- desirable -- 0.01 to 0.99 -- it is by 0.1 to 0.9 still more preferably, and is from 0.2 to 0.8 ideally.
[0114]Also when opposite to **** as other examples, it is effective and is.
[0115]$C_{LC1}/C_{NL1}<C_{LC2}/C_{NL2}$ -- (12)
Namely, $S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$ -- (13)
Even if it carries out, the completely same effect as **** is acquired. When ctenidium-like first pixel electrode area S_{LC1} and ctenidium-like second pixel electrode area S_{LC2} are made equal, it

is $S_{LC1}=S_{LC2}$. -- (7)
the [area S_{NL1} of the first MIM element that exists by a non-line type resistance element for a start, and] -- the relation of area S_{NL2} of the second MIM element that exists by a 2 non-line type resistance element -- $S_{NL1}>S_{NL2}$-- (14)
Then, the relation of (13) types is filled, and a wide viewing angle and high definition are compatible, and also defective repair also becomes possible effectively. When the ratio to area $S_{LC1}+S_{LC2}$ which set the ctenidium-like first picture element electrode, and the ctenidium-like second picture element electrode of ctenidium-like second pixel electrode area S_{LC2} is made into $kappa_2$, it is $kappa_2=S_{LC2}/(S_{LC1}+S_{LC2})$. -- (15)
like the above-mentioned, a wide viewing angle is reconciled with high definition, and also there is a value of desirable $kappa_2$ which can carry out defective repair effectively by 0.1 to 0.9 -- more -- desirable -- 0.2 to 0.8 -- it is 0.3 to 0.7 still more preferably, and is from 0.4 to 0.6 ideally.
[0116]A view angle characteristic improves, when it is in the relation which fills the above-mentioned (12) types, or the relation which fills (13) types.
[0117]
$C_{LC1}/C_{NL1}=m_2\ (C_{LC2}/C_{NL2})$ -- (16)
When the above-mentioned (16) formula defines coefficient m_2, (12) type (13) type is $m_2<1$. -- (17)
It is described. at this time, there is the range of the value of desirable m_2 by 0.001 to 0.999 in consideration of image quality, MIM element structure, and picture element electrode structure -- more -- desirable -- 0.01 to 0.99 -- it is by 0.1 to 0.9 still more preferably, and is from 0.2 to 0.8 ideally.
[0118]The MIM type non-line type resistance element used by this example as the 1st conductor Ta and TaMo, The alloy etc. which use as an ingredient the alloy which uses Ta, such as TaW, TaSi, and TaSiW, as an ingredient or aluminum, and aluminum are possible, it is, these first conductor is oxidized by the anode oxidation method or a thermal oxidation method in this case, and an insulator may be formed. When these alloy and other conductors are used as the 1st conductor, it is the same as that of other examples which may use the silicon nitride which the insulator formed with a sputtering technique or plasma CVD method, and there is.
[0119][Example 9] Another example of this invention is explained using drawing 14 and drawing 15. Drawing 14 and drawing 15 show the shape of the picture element electrode linked to the switching element formed in the 1st substrate side, and its switching element. The liquid crystal display of this invention comprises two or more liquid crystal driving electrodes formed in the first substrate side at matrix form since a liquid crystal was driven, and a switching element connected to this liquid crystal driving electrode. One liquid crystal driving electrode is divided into the ctenidium-like first picture element electrode, and the ctenidium-like second picture element electrode, the first switching element is connected to the ctenidium-like first picture element electrode, and the second switching element is connected to the ctenidium-like second picture element electrode. Since the ctenidium-like first picture element electrode, and the ctenidium-like second picture element electrode have got into gear mutually, there are. About the effect which a mutually biting comb place-like picture element electrode brings about, i.e., defective repair capability, although it differs from Example 8 in that the TFT element is used as a switching element at this example, it is completely the same and is. Therefore, among those it also explained the relation between the minimum width and the maximum width wmax of a ctenidium-like picture element electrode, and the separation distance d between picture element electrodes in full detail in Example 8, it is the same as that of **, and is. If the area of the first picture element electrode and the area of the second picture element electrode are still more nearly equal, it turns to carrying out defective repair more effectively.
[0120]Now, one liquid crystal driving electrode is divided into the ctenidium-like first picture

element electrode 1511, and the ctenidium-like second picture element electrode 1512 in drawing 14. The first thin film transistor 1501 is connected to the ctenidium-like first picture element electrode 1511, and the second thin film transistor 1502 is connected to the ctenidium-like second picture element electrode 1512. Here, the first thin film transistor and the second thin film transistor are as same electric conduction type. So, the gate electrode of the first thin film transistor is also connected to the scanning line 152 also with a common gate electrode of the second thin film transistor. In order to impress common signal potential to the first and the second picture element electrode, the source electrode of the first thin film transistor and the source electrode of the second thin film transistor are also connected to the common signal wire 153. When it has such composition, one liquid crystal driving electrode comprises one picture element electrode, and the liquid crystal display of the invention in this application is manufactured in the completely same manufacturing process as the conventional liquid crystal display depended and switched to one thin film transistor. The liquid crystal display of the invention in this application may be driven with the completely same drive method as the former. Without applying new load in any way to conventional technology after all, since it changes that it is possible to make the effective automatic defective repair capability mentioned above have, it is.

[0121]On the other hand, by drawing 15, one liquid crystal driving electrode is divided into the first picture element electrode 1611 and the second picture element electrode 1612, the first thin film transistor 1601 is connected to the first picture element electrode 1611, and the second thin film transistor 1602 is connected to the second picture element electrode 1612. The gate electrode of the first thin film transistor is connected to the first scanning line 1621 here, and the gate electrode of the second thin film transistor is connected to the second scanning line 1622. The source electrode of the first thin film transistor and the source electrode of the second thin film transistor are connected to the common signal wire 163. Furthermore, the first thin film transistor 1601 and the second thin film transistor 1602 change with the reverse electric conduction type mutually. For example, if there is the first thin film transistor 1601 by an N type electric conduction type, there is the second thin film transistor 1602 by a P type electric conduction type. It ****s in this and the scanning signal of reverse polarity is impressed to the first scanning line and the second scanning line to the always same timing. If a previous example is followed, when the scanning lines 1621 and 1622 will be chosen simultaneously, the signal potential of High is impressed to the first scanning line to which N type TFT was connected, and N type TFT1601 changes with on state. The signal potential of Low is impressed to the second scanning line to which another side P type TFT was connected, and P type TFT1602 changes with on state. The signal potential of Low is impressed to the first scanning line to which N type TFT was connected for these signal wires in the state of non selection on the contrary, the signal potential of High is impressed to the second scanning line to which P type TFT was connected, and both TFT(s) change with an off state. In order to connect the first thin film transistor and the second thin film transistor to the same signal wire 163 and also to always perform on-off to the same timing, the same signal potential is always impressed to the first picture element electrode and the second picture element electrode. In this application, the switching element connected to the liquid crystal driving electrode at this appearance has taken CMOS structure. For the reason, it adheres to the polar positive/negative of signal potential, and right potential may always be impressed to a liquid crystal driving electrode as a whole that there is nothing. For example, when the signal potential of straight polarity goes into the signal wire 163, gate potential (V_{gs}) falls and keeps in the conventional liquid crystal display to which a switching element changes only from N type TFT, It was without it being able to impress right potential to a liquid crystal driving electrode within the selection time limited by on resistance of a reason transistor increasing. On the other hand, in the invention in this application, since it changes with CMOS structure, one of TFT(s) certainly change with a full on state. If a previous example is followed, the gate potential of N type TFT falls, and on resistance of N type TFT changes greatly, but on the other hand, the gate potential of P type TFT increased, and on resistance of P type TFT has turned into the minimum (P type TFT is a full on state). When the

signal potential of negative polarity is impressed to the signal wire 163, N type TFT changes with a full on state by the contrary of this example. To having been without having changed on resistance of TFT according to signal potential and the conventional liquid crystal display's being able to display right information, when putting in another way, by the invention in this application, since it adheres to signal potential, on resistance is equalized that there is nothing, and the change changes small, therefore right information may always be displayed, it is. In addition, at the invention in this application, HitoshiTamehira-ization to which light mixing (mixing of the light modulated with the first picture element electrode and the light modulated with the second picture element electrode) is carried out with the ctenidium-like picture element electrode progresses further, and there is by the reason a right display always changes possible to all status signals. Feel setting a pixel switching element to CMOS TFT so that a manufacturing new process can be searched for, but. Since a CMOS circuit is usually adopted when it builds in a scanning line circuit and a signal wire circuit on a substrate with the polycrystalline semiconductor (for example, poly-Si) TFT, in such a liquid crystal display, the invention in this application does not come to add a new process at all. ** -- it can be said that especially the invention in this application is suitable for the liquid crystal display which contained the peripheral circuit (the parts of a scanning line circuit, a signal wire circuit, etc. or all) with the polycrystalline thin film semiconductor device from the viewpoint [like].

[0122]Now, when the first thin film transistor 1601 is considered as an N type electric conduction type and the second thin film transistor 1602 is considered as a P type electric conduction type, As for the area of the first picture element electrode 1611 that the first thin film transistor connected, it is preferred that it is larger than the area of the second picture element electrode 1612 that the second thin film transistor connected. This originates in the on resistance of N type TFT being smaller than on resistance of P type TFT, when transistor size (length and width of a channel) of N type TFT and P type TFT is made the same. The equalization previously described by carrying out like this progresses further, and since a more exact information display is realized, there is. Of course, if the first picture element electrode 1611 and the second picture element electrode 1612 have got into gear mutually by the shape of a ctenidium, the equalization which depends on light mixing is also attained simultaneously, and is still more preferred.

[0123]As explained in full detail in the example to this, when dividing one liquid crystal driving electrode into two or more picture element electrodes, it is desired for each picture element electrode area to be equal. Since it depends on this and the self-repair capability of a defect improves much more, it is. Therefore, it can be said that the direction which made two picture element electrode area the same, and made the element characteristic the same than the above-mentioned method of making the difference of on resistance of N type TFT and P type TFT offset by difference of picture element electrode area is excellent. As for this, the liquid crystal driving electrode is divided into the first picture element electrode 1611 and the second picture element electrode 1612, The first N type electric conduction type thin film transistor 1601 is connected to the first picture element electrode, The second P type electric conduction type thin film transistor 1602 is connected to the second picture element electrode, The gate electrode of the first thin film transistor is connected to the first scanning line 1621, The gate electrode of the second thin film transistor is connected to the second scanning line 1622, When channel length of the first thin film transistor was made into L_1, channel width was made into W_1, channel length of the second thin film transistor is made into L_2 and channel width is made into W_2, it is attained by filling an expression of relations with $W_1/L_1<W_2/L_2$. There is this by the thing which adjusts a difference of the channel conductance (electrical conductivity which becomes settled with mobility or threshold voltage) of N type TFT and P type TFT by a channel dimension (L and W), and arranges on resistance. Since the channel conductance of N type TFT is usually larger than the channel conductance of P type TFT, If W/L of N type TFT is made smaller than W/L of P type TFT like an above-mentioned expression of relations, on current of both TFT(s) can be arranged, and, making two picture element electrode potential equivalent in addition also as the same in two picture element electrode area so is realized. Of course, this is

attained also by a relation that the channel length of the first thin film transistor is longer than the channel length of the second thin film transistor, when it is said from the convenience of a layout, etc. that W of both TFT(s) is equal etc. It does not matter, though the channel width of the first thin film transistor is narrower than the channel width of the second thin film transistor similarly. Although the first picture element electrode and the second picture element electrode have got into gear mutually by the shape of a ctenidium as shown in drawing 15, and both area is sometimes equal by an ideal, these conditions are not necessarily fulfilled but a certain amount of [**] effect is expected.

[0124]

[Effect of the Invention]By driving a liquid crystal driving electrode by this invention by the first MIM element and the second MIM element which the first picture element electrode and the second picture element electrode constituted so that the circumference of this first picture element electrode might be surrounded divided, were boiled, respectively, and were provided independently, the visual angle characteristic from all directions improves, and defective repair is attained. Each area of the first picture element electrode, the second picture element electrode, the first MIM element, and the second MIM element S_{LC1}, By considering it as S_{LC2}, S_{NL1}, and S_{NL2}, and changing the ratio of S_{LC1}/S_{NL1} to S_{LC2}/S_{NL2}, The effective voltage of the liquid crystal layer driven with the first picture element electrode and the effective voltage of the liquid crystal layer driven with the second picture element electrode can be controlled independently, and a visual angle characteristic can be improved. By filling the relation of $S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$, KONTORANSUTO when a liquid crystal display is seen from a transverse plane can be secured with the first picture element electrode, contrast when it sees from across can be secured with the second picture element electrode, NEGAPOJI reversal when a screen is seen from across can be prevented, and the high liquid crystal display of display quality can be realized. (10) Depend on limiting the value of coefficient m_1 of a formula, or coefficient m_2 of (16) types, and a view angle characteristic improves remarkably. It depends on filling (7) types, (8) types or (7) types, and (14) types, and is compatible with a high angle of visibility in high definition, and also defective repair can be carried out effectively. (9) Depend on carrying out the numerical limitation of κ_1 of a formula, or the κ_2 of (15) types, and a high angle of visibility and high definition are compatible.

[0125]By filling the relation of $S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$, contrast when a liquid crystal display is seen from a transverse plane is secured with the second picture element electrode, contrast when it sees from across is secured with the first picture element electrode, and a liquid crystal display with a large angle of visibility can be realized. An easy means to change a photo mask can realize these, without acquiring the above-mentioned effect and complicating structure and a process by only changing surface ratio.

[0126]One liquid crystal driving electrode is divided into n picture element electrodes, and the flexibility which raises a visual angle characteristic can extend by driving each picture element electrode by the independent MIM element. When it divides with n= 3, the area of a picture element electrode, respectively For example, S_{LC1}, The area of the MIM element which considers it as S_{LC2} and S_{LC3}, and drives each picture element electrode, respectively S_{NL1}, Consider it as S_{NL2} and S_{NL3}, and $S_{LC3}/S_{NL3}>S_{LC2}/S_{NL2}>S_{LC1}/S_{NL1}$. Or $S_{LC3}/S_{NL3}<S_{LC2}/S_{NL2}<S_{LC1}/S_{NL1}$. Or $S_{LC3}/S_{NL3}=S_{LC1}/S_{NL1}<S_{LC2}/S_{LC2}$. Or a visual angle characteristic can be improved by leaps and bounds by filling the relation between either $S_{LC3}/S_{NL3}<S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$ or $S_{LC1}/S_{NL1}<S_{LC3}/S_{NL3}<S_{LC2}/S_{NL2}$. A liquid crystal driving electrode is not limited to trichotomy, but a bigger effect can be expected by carrying out comparatively for n minutes, When it applies to the large-sized liquid crystal display of 25 cm - about 50 cm of vertical angles especially used for the object for PC, or EWS, even if it is fixing eyes, the problem that a color tone differs from contrast by the upper and lower sides of a screen can be solved.

[0127]A liquid crystal driving electrode is divided into two, the non-line type characteristic is

controlled by changing the thickness of the insulator of two MIM elements which drive each independently, and, as a result, improvement in a visual angle characteristic is attained. Or by changing simultaneously not only the thickness of the insulator of a MIM element but area, the flexibility of the improvement in a visual angle characteristic can extend substantially.
[0128]When forming the insulator of a MIM element with an anode oxidation method, the insulator of two MIM elements can be anodized with a separate kind of solution, the non-line type characteristic of an insulator can be controlled, and the same effect as the point can be expected.
[0129]By dividing a liquid crystal driving electrode two and combining the divided liquid crystal driving electrode by a MIM element, the effective voltage impressed to a liquid crystal layer is controlled independently, and the diagonal characteristic can be improved.
[0130]The liquid crystal driving electrode was divided into two or more picture element electrodes, and defective repair capability and gradation display properties were made to improve remarkably by mixing effectively the light modulated with each picture element electrode.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]Drawing 1 is a figure showing the liquid crystal display of this invention concerning Example 1.
[Drawing 2]Drawing 2 is a figure showing the conventional liquid crystal display.
[Drawing 3]Drawing 3 is a figure showing the liquid crystal display of this invention concerning Example 2.
[Drawing 4]Drawing 4 is a figure showing the liquid crystal display of this invention concerning Example 3.
[Drawing 5]Drawing 5 is a schematic diagram at the time of anodization concerning this invention of Example 3.
[Drawing 6]Drawing 6 is a figure showing the liquid crystal display of this invention concerning Example 4.
[Drawing 7]Drawing 7 is a figure showing the equivalent circuit of the liquid crystal display of this invention concerning Example 4.
[Drawing 8]Drawing 8 is a figure showing the liquid crystal display of this invention concerning Example 5.
[Drawing 9]Drawing 9 is a figure showing the liquid crystal display of this invention concerning Example 5.
[Drawing 10]Drawing 10 is a figure showing the liquid crystal display of this invention concerning Example 6.
[Drawing 11]Drawing 11 is a figure showing the liquid crystal display of this invention concerning Example 7.
[Drawing 12]Drawing 12 is a figure showing the liquid crystal display of this invention concerning Example 8.
[Drawing 13]Drawing 13 is a figure showing the liquid crystal display of this invention concerning Example 8.
[Drawing 14]Drawing 14 is a figure showing the liquid crystal display of this invention concerning Example 9.
[Drawing 15]Drawing 15 is a figure showing the liquid crystal display of this invention concerning Example 9.
[Drawing 16]There is drawing 16 with the figure showing the conventional liquid crystal display.
[Description of Notations]
101, 201, 401, 601, 701 -- The 1st substrate
102, 202, 402, 702 -- The 2nd substrate
103, 203, 403, 703 -- The 1st conductor
104, 204, 404, 705 -- Insulator
105, 407, 507, 706, 905, 1005, 1105, 1211, 1703 -- The first picture element electrode
106, 406, 508, 707, 906, 1006, 1106, 1212, 1704 -- The second picture element electrode
1213 -- The third picture element electrode
1214 -- The fourth picture element electrode
1311, 1331, 1411, 1431, 1511, 1611 -- The ctenidium-like first picture element electrode

1312, 1332, 1412, 1432, 1512, 1612 -- The ctenidium-like second picture element electrode
108, 206, 708, 802 -- Data line
109, 112, 113, 114, 207, 409, 415, 416, 417, 709, 806, 807 -- Liquid crystal layer
111, 410, 509, 710, 803, 911, 1011, 1111, 1201, 1301, 1321, 1401, 1421, 1705 -- The first MIM element
110, 411, 510, 711, 804, 910, 1010, 1110, 1202, 1302, 1322, 1402, 1422, 1706 -- The second MIM element
1203 -- The third MIM element
1204 -- The fourth MIM element
205 -- Liquid crystal driving electrode
208 -- MIM element
405 -- The third picture element electrode
412, 712, 805 -- The third MIM element
408, 506, 801 -- Scanning wiring
413, 414 -- Arrow
501, 602 -- The 1st data line
502, 603 -- The 2nd data line
503 -- The 1st insulator
504 -- The 2nd insulator
511, 604 -- Terminal area
505 -- Putt electrode
605 -- The 1st anodization putt
606 -- The 2nd anodization putt
607, 608 -- Dashed line
704 -- The 3rd conductor
1015, 1016 -- The second conductor
1701 -- Counterelectrode
1702 -- Wiring
1501, 1601 -- The first thin film transistor
1502, 1602 -- The second thin film transistor
152 -- Scanning line
153 -- Signal wire
1621 -- The first scanning line
1622 -- The second scanning line
163 -- Signal wire

[Translation done.]

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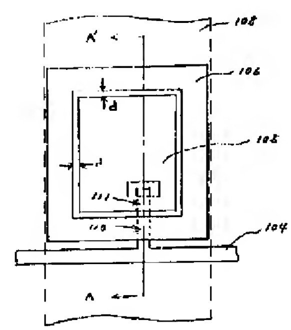
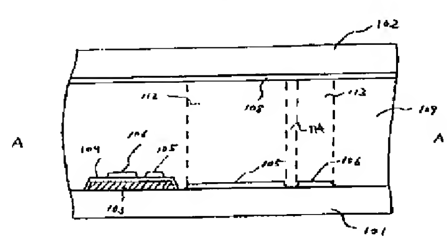
(54)【発明の名称】　液晶表示装置

(57)【要約】
【課題】広視野角と高画質とを両立した液晶表示装置を提供する。
【解決手段】非線型抵抗素子と、液晶を駆動する液晶駆動電極と、を含んで構成される液晶表示装置において、前記液晶駆動電極が、第一画素電極と、前記第一画素電極の周辺部に形成された第二画素電極と、で構成され、前記第一画素電極と前記第二画素電極とをそれぞれ駆動する第一非線型抵抗素子と第二非線型抵抗素子とを設ける。



(a)



(b)

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【特許請求の範囲】

【請求項１】　非線型抵抗素子と、液晶を駆動する液晶駆動電極と、を含んで構成される液晶表示装置において、
前記液晶駆動電極が、第一画素電極と、前記第一画素電極の周辺部に形成された第二画素電極と、で構成され、
前記第一画素電極と前記第二画素電極とをそれぞれ駆動する第一非線型抵抗素子と第二非線型抵抗素子とを設けた事を特徴とする液晶表示装置。

【請求項２】　前記第一非線型抵抗素子と前記第二非線型抵抗素子とは、導電体－絶縁体－導電体を順次積層した構造を有し、
それぞれの非線型抵抗素子面積をS_{NL1}、S_{NL2}とし、前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}としたとき、
$S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$
を満たす事を特徴とする請求項１記載の液晶表示装置。

【請求項３】　前記第一非線型抵抗素子と前記第二非線型抵抗素子とは、導電体－絶縁体－導電体を順次積層した構造を有し、
それぞれの非線型抵抗素子容量をC_{NL1}、C_{NL2}とし、前記第一画素電極で駆動される液晶層の容量をC_{LC1}、前記第二画素電極で駆動される液晶層の容量をC_{LC2}とし、
$C_{LC2}/C_{NL2}=m_1(C_{LC1}/C_{NL1})$
上式にて係数m_1を定義したとき、
m_1の値の範囲が０．００１から０．９９９の間で有る事を特徴とする請求項１記載の液晶表示装置。

【請求項４】　前記第一非線型抵抗素子と前記第二非線型抵抗素子とは、導電体－絶縁体－導電体を順次積層した構造を有し、
それぞれの非線型抵抗素子面積をS_{NL1}、S_{NL2}とし、前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}としたとき、
$S_{LC1}=S_{LC2}$、かつ、$S_{NL1}<S_{NL2}$
を満たす事を特徴とする請求項１記載の液晶表示装置。

【請求項５】　前記第一画素電極面積S_{LC1}の、前記第一画素電極と前記第二画素電極とを合わせた面積$S_{LC1}+S_{LC2}$に対する比をκ_1（$\kappa_1=S_{LC1}/(S_{LC1}+S_{LC2})$）としたとき、
κ_1の値が０．１から０．９の間に有る事を特徴とする請求項２記載の液晶表示装置。

【請求項６】　前記第一非線型抵抗素子と前記第二非線型抵抗素子は、導電体－絶縁体－導電体を順次積層した構造を有し、
それぞれの非線型抵抗素子面積をS_{NL1}、S_{NL2}とし、前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}としたとき、
$S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$
を満たす事を特徴とする請求項１記載の液晶表示装置。

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【請求項７】　前記第一非線型抵抗素子と前記第二非線型抵抗素子は、導電体－絶縁体－導電体を順次積層した構造を有し、
それぞれの非線型抵抗素子容量をC_{NL1}、C_{NL2}とし、前記第一画素電極で駆動される液晶層の容量をC_{LC1}、前記第二画素電極で駆動される液晶層の容量をC_{LC2}とし、
$C_{LC1}/C_{NL1}=m_2(C_{LC2}/C_{NL2})$
上式にて係数m_2を定義したとき、
m_2の値の範囲が０．００１から０．９９９の間で有る事を特徴とする請求項１記載の液晶表示装置。

【請求項８】　前記第一非線型抵抗素子と前記第二非線型抵抗素子は、導電体－絶縁体－導電体を順次積層した構造を有し、
それぞれの非線型抵抗素子面積をS_{NL1}、S_{NL2}とし、前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}としたとき、
$S_{LC1}=S_{LC2}$、　$S_{NL1}>S_{NL2}$
を満たす事を特徴とする請求項１記載の液晶表示装置。

【請求項９】　前記第二画素電極面積S_{LC2}の第一画素電極と第二画素電極を合わせた面積$S_{LC1}+S_{LC2}$に対する比をκ_2としたとき、
$\kappa_2=S_{LC2}/(S_{LC1}+S_{LC2})$
κ_2の値が０．１から０．９の間に有る事を特徴とする請求項６記載の液晶表示装置。

【請求項１０】　液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極を構成要素の一つとする液晶表示装置において、
前記液晶駆動電極の夫々が複数個の画素電極に分割され、該画素電極間の分離距離ｄが１０μｍ以下である事を特徴とする液晶表示装置。

【請求項１１】　液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極と、導電体－絶縁体－導電体を順次積層した構造を有する非線型抵抗素子とを含んで構成される液晶表示装置において、
前記液晶駆動電極が前記液晶表示装置の広視野角が求められる方向にｎ個（ｎ≧２の整数）の画素電極に分割され、
該画素電極の其れぞれには非線型抵抗素子が設けられて居り、
ｉ番目（ｉは１からｎの間の任意の整数）の画素電極の面積S_{LCi}とし、ｉ番目の画素電極に設けられた非線型抵抗素子の面積をS_{NLi}としたとき、
ｎ個のS_{LCi}/S_{NLi}の値が少なくとも２種類以上である事を特徴とする液晶表示装置。

【請求項１２】　前記液晶駆動電極が前記液晶表示装置の水平方向にｎ個（ｎ≧２の整数）の画素電極に分割されている事を特徴とする請求項１１記載の液晶表示装置。

【請求項１３】　前記液晶駆動電極が前記液晶表示装置

の垂直方向にｎ個（ｎ≧２の整数）の画素電極に分割されている事を特徴とする請求項１１記載の液晶表示装置。

【請求項１４】　前記ｉ番目のS_{LCi}/S_{NLi}の値とｎ＋１－ｉ番目の$S_{LC(n+1-i)}/S_{NL(n+1-i)}$の値が等しい事を特徴とする請求項１１及び、請求項１２、請求項１３記載の液晶表示装置。

【請求項１５】　前記液晶駆動電極が３分割された事を特徴とする請求項１１及び請求項１２、請求項１３、請求項１４記載の液晶表示装置。

【請求項１６】　液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極と、導電体－絶縁体－導電体を順次積層した構造を有する非線型抵抗素子と、を含んで構成される液晶表示装置において、
前記液晶駆動電極が第一画素電極と第二画素電極とに分割されて居り、前記第二画素電極は前記第一画素電極を囲い、且つ、前記第二画素電極の一部は前記第一画素電極の内側に延在されて居る事を特徴とする液晶表示装置。

【請求項１７】　前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}、前記第一画素電極に設けられた非線型抵抗素子の面積をS_{NL1}、前記第二画素電極に設けられた非線型抵抗素子の面積をS_{NL2}、としたとき、
$S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$
を満たす事を特徴とする請求項１６記載の液晶表示装置。

【請求項１８】　前記第一非線型抵抗素子と前記第二非線型抵抗素子とは、導電体－絶縁体－導電体を順次積層した構造を有し、
それぞれの非線型抵抗素子容量をC_{NL1}、C_{NL2}とし、前記第一画素電極で駆動される液晶層の容量をC_{LC1}、前記第二画素電極で駆動される液晶層の容量をC_{LC2}とし、
$C_{LC2}/C_{NL2}=m_1(C_{LC1}/C_{NL1})$
上式にて係数m_1を定義したとき、
m_1の値の範囲が０．００１から０．９９９の間で有る事を特徴とする請求項１６記載の液晶表示装置。

【請求項１９】　前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}、前記第一画素電極に設けられた非線型抵抗素子の面積をS_{NL1}、前記第二画素電極に設けられた非線型抵抗素子の面積をS_{NL2}、としたとき、
$S_{LC1}=S_{LC2}$、かつ、$S_{NL1}<S_{NL2}$
を満たす事を特徴とする請求項１６記載の液晶表示装置。

【請求項２０】　前記第一画素電極面積S_{LC1}の、前記第一画素電極と前記第二画素電極とを合わせた面積$S_{LC1}+S_{LC2}$に対する比をκ_1（$\kappa_1=S_{LC1}/(S_{LC1}+S_{LC2})$）としたとき、$\kappa_1$の値が０．０５から０．８の間に有る事を特徴とする請求項１７記載の液晶表示装置。

【請求項２１】　前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}、前記第一画素電極に設けられた非線型抵抗素子の面積をS_{NL1}、前記第二画素電極に設けられた非線型抵抗素子の面積をS_{NL2}、としたとき、
$S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$
を満たす事を特徴とする請求項１６記載の液晶表示装置。

【請求項２２】　前記第一非線型抵抗素子と前記第二非線型抵抗素子とは、導電体－絶縁体－導電体を順次積層した構造を有し、
それぞれの非線型抵抗素子容量をC_{NL1}、C_{NL2}とし、前記第一画素電極で駆動される液晶層の容量をC_{LC1}、前記第二画素電極で駆動される液晶層の容量をC_{LC2}とし、
$C_{LC1}/C_{NL1}=m_2(C_{LC2}/C_{NL2})$
上式にて係数m_2を定義したとき、
m_2の値の範囲が０．００１から０．９９９の間で有る事を特徴とする請求項１６記載の液晶表示装置。

【請求項２３】　前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}、前記第一画素電極に設けられた非線型抵抗素子の面積をS_{NL1}、前記第二画素電極に設けられた非線型抵抗素子の面積をS_{NL2}、としたとき、
$S_{LC1}=S_{LC2}$、かつ$S_{NL1}>S_{NL2}$
を満たす事を特徴とする請求項１６記載の液晶表示装置。

【請求項２４】　前記第二画素電極面積S_{LC2}の、第一画素電極と第二画素電極とを合わせた面積$S_{LC1}+S_{LC2}$に対する比をκ_2としたとき、
$\kappa_2=S_{LC2}/(S_{LC1}+S_{LC2})$
κ_2の値が０．２から０．９５の間に有る事を特徴とする請求項２１記載の液晶表示装置。

【請求項２５】　液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極と、導電体－絶縁体－導電体を順次積層した構造を有する非線型抵抗素子と、を含んで構成される液晶表示装置において、
前記液晶駆動電極が第一画素電極と第二画素電極に分割されて居り、
前記第二画素電極は前記第一画素電極を囲い、且つ前記第二画素電極の一部は前記第一画素電極の内側に延在されて居り、
更に前記第一画素電極の一部は前記第二画素電極の内側に延在されて居る事を特徴とする液晶表示装置。

【請求項２６】　前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}、前記第一画素電極に設けられた非線型抵抗素子の面積をS_{NL1}、前記第二画素電極に設けられた非線型抵抗素子の面積をS_{NL2}、としたとき、

$S_{LC1}／S_{NL1}＞S_{LC2}／S_{NL2}$
を満たす事を特徴とする請求項２５記載の液晶表示装置。

【請求項２７】　前記第一非線型抵抗素子と前記第二非線型抵抗素子とは、導電体－絶縁体－導電体を順次積層した構造を有し、それぞれの非線型抵抗素子容量をC_{NL1}、C_{NL2}とし、前記第一画素電極で駆動される液晶層の容量をC_{LC1}、前記第二画素電極で駆動される液晶層の容量をC_{LC2}とし、
$C_{LC2}／C_{NL2}＝m_1（C_{LC1}／C_{NL1}）$
上式にて係数m_1を定義したとき、
m_1の値の範囲が０．００１から０．９９９の間で有る事を特徴とする請求項２５記載の液晶表示装置。

【請求項２８】　前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}、前記第一画素電極に設けられた非線型抵抗素子の面積をS_{NL1}、前記第二画素電極に設けられた非線型抵抗素子の面積をS_{NL2}、としたとき、
$S_{LC1}＝S_{LC2}$、かつ、$S_{NL1}＜S_{NL2}$
を満たす事を特徴とする請求項２５記載の液晶表示装置。

【請求項２９】　前記第一画素電極面積S_{LC1}の、前記第一画素電極と前記第二画素電極とを合わせた面積$S_{LC1}＋S_{LC2}$に対する比をκ_1としたとき、
$\kappa_1＝S_{LC1}／（S_{LC1}＋S_{LC2}）$
κ_1の値が０．１から０．９の間に有る事を特徴とする請求項２６記載の液晶表示装置。

【請求項３０】　前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}、前記第一画素電極に設けられた非線型抵抗素子の面積をS_{NL1}、前記第二画素電極に設けられた非線型抵抗素子の面積をS_{NL2}、としたとき、
$S_{LC1}／S_{NL1}＜S_{LC2}／S_{NL2}$
を満たす事を特徴とする請求項２５記載の液晶表示装置。

【請求項３１】　前記第一非線型抵抗素子と前記第二非線型抵抗素子とは、導電体－絶縁体－導電体を順次積層した構造を有し、
それぞれの非線型抵抗素子容量をC_{NL1}、C_{NL2}とし、前記第一画素電極で駆動される液晶層の容量をC_{LC1}、前記第二画素電極で駆動される液晶層の容量をC_{LC2}とし、
$C_{LC1}／C_{NL1}＝m_2（C_{LC2}／C_{NL2}）$
上式にて係数m_2を定義したとき、
m_2の値の範囲が０．００１から０．９９９の間で有る事を特徴とする請求項２５記載の液晶表示装置。

【請求項３２】　前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}、前記第一画素電極に設けられた非線型抵抗素子の面積をS_{NL1}、前記第二画素電極に設けられた非線型抵抗素子の面積をS_{NL2}、としたとき、
$S_{LC1}＝S_{LC2}$、かつ、$S_{NL1}＞S_{NL2}$
を満たす事を特徴とする請求項２５記載の液晶表示装置。

【請求項３３】　前記第二画素電極面積S_{LC2}の、第一画素電極と第二画素電極とを合わせた面積$S_{LC1}＋S_{LC2}$に対する比をκ_2としたとき、
$\kappa_2＝S_{LC2}／（S_{LC1}＋S_{LC2}）$
κ_2の値が０．１から０．９の間に有る事を特徴とする請求項３０記載の液晶表示装置。

【請求項３４】　液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極と、導電体－絶縁体－導電体を順次積層した構造を有する非線型抵抗素子と、を含んで構成される液晶表示装置において、
前記液晶駆動電極がｎ個（ｎ≧２の整数）の同心状画素電極に分割され、
該同心状画素電極の其れぞれには非線型抵抗素子が設けられて居る事を特徴とする液晶表示装置。

【請求項３５】　前記同心状画素電極のｉ番目（ｉは１からｎの間の任意の整数）の同心状画素電極の面積をS_{LCi}とし、ｉ番目の同心状画素電極に設けられた非線型抵抗素子の面積をS_{NLi}としたとき、
ｎ個のS_{LCi}/S_{NLi}の値が少なくとも２種類以上である事を特徴とする請求項３４記載の液晶表示装置。

【請求項３６】　前記ｎ個（ｎ≧２の整数）の同心状画素電極の最小幅が該同心状画素電極間の分離距離の３倍以上で有る事を特徴とする請求項３４記載の液晶表示装置。

【請求項３７】　前記ｎ個（ｎ≧２の整数）の同心状画素電極の最大幅が５μｍ以下で、且つ、該同心状画素電極間の分離距離が１μｍ以下で有る事を特徴とする請求項３４記載の液晶表示装置。

【請求項３８】　前記同心状画素電極のｉ番目（ｉは１からｎの間の任意の整数）の同心状画素電極の面積をS_{LCi}とし、ｉ番目の同心状画素電極に設けられた非線型抵抗素子の面積をS_{NLi}とし、更に最も内側に位置する画素電極を第一画素電極とし、それに接続した非線型抵抗素子を第一ＭＩＭ素子と名付け、以下順次外側に進むにつれ第二、第三とし、最も外側に位置する画素電極と非線型抵抗素子をそれぞれ第ｎ画素電極及び第ｎＭＩＭ素子としたとき、
$S_{LCi}／S_{NLi}＜S_{LCi+1}／S_{NLi+1}$
を満たす事を特徴とする請求項３４記載の液晶表示装置。

【請求項３９】　前記ｎ個の非線型抵抗素子の面積が総て等しい事を特徴とする請求項３８記載の液晶表示装置。

【請求項４０】　前記ｎ個の同心状画素電極の面積が総て等しい事を特徴とする請求項３８記載の液晶表示装置。

【請求項４１】　前記同心状画素電極のｉ番目（ｉは１からｎの間の任意の整数）の同心状画素電極の面積S_{LCi}とし、ｉ番目の同心状画素電極に設けられた非線型抵抗素子の面積をS_{NLi}とし、更に最も内側に位置する画素電極を第一画素電極とし、それに接続した非線型抵抗素子を第一ＭＩＭ素子と名付け、以下順次外側に進むにつれ第二、第三とし、最も外側に位置する画素電極と非線型抵抗素子をそれぞれ第ｎ画素電極及び第ｎＭＩＭ素子としたとき、

$S_{LCi}/S_{NLi}>S_{LCi+1}/S_{NLi+1}$

を満たす事を特徴とする請求項３４記載の液晶表示装置。

【請求項４２】　前記ｎ個の非線型抵抗素子の面積が総て等しい事を特徴とする請求項４１記載の液晶表示装置。

【請求項４３】　前記ｎ個の同心状画素電極の面積が総て等しい事を特徴とする請求項４１記載の液晶表示装置。

【請求項４４】　液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極と、該液晶駆動電極に接続されたスイッチング素子とで構成される液晶表示装置において、

前記液晶駆動電極が櫛歯状第一画素電極と櫛歯状第二画素電極に分割されて居り、前記櫛歯状第一画素電極には第一スイッチング素子が接続され、

前記櫛歯状第二画素電極には第二スイッチング素子が接続され、

前記櫛歯状第一画素電極と前記櫛歯状第二画素電極は互いに噛合って居る事を特徴とする液晶表示装置。

【請求項４５】　前記スイッチング素子は導電体－絶縁体－導電体を順次積層した構造を有する非線型抵抗素子で有る事を特徴とする請求項４４記載の液晶表示装置。

【請求項４６】　前記櫛歯状第一画素電極と前記櫛歯状第二画素電極は水平方向に互いに噛合って居る事を特徴とする請求項４５記載の液晶表示装置。

【請求項４７】　前記櫛歯状第一画素電極と前記櫛歯状第二画素電極は垂直方向に互いに噛合って居る事を特徴とする請求項４５記載の液晶表示装置。

【請求項４８】　前記櫛歯状第一画素電極の面積をS_{LC1}、前記櫛歯状第二画素電極の面積をS_{LC2}、前記櫛歯状第一画素電極に設けられた第一非線型抵抗素子の面積をS_{NL1}、前記櫛歯状第二画素電極に設けられた第二非線型抵抗素子の面積をS_{NL2}としたとき、

$S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$

を満たす事を特徴とする請求項４５、請求項４６又は請求項４７記載の液晶表示装置。

【請求項４９】　前記第一スイッチング素子及び前記第二スイッチング素子は其々導電体－絶縁体－導電体を順次積層した構造を有する第一非線型抵抗素子と第二非線型抵抗素子から成り、

其々の非線型抵抗素子容量をC_{NL1}、C_{NL2}とし、前記櫛歯状第一画素電極で駆動される液晶層の容量をC_{LC1}、前記櫛歯状第二画素電極で駆動される液晶層の容量をC_{LC2}とし、

$C_{LC2}/C_{NL2}=m_1(C_{LC1}/C_{NL1})$

上式にて係数m_1を定義したとき、

m_1の値の範囲が０．００１から０．９９９の間で有る事を特徴とする請求項４５、又は請求項４６、請求項４７記載の液晶表示装置。

【請求項５０】　前記櫛歯状第一画素電極の面積をS_{LC1}、前記櫛歯状第二画素電極の面積をS_{LC2}、前記櫛歯状第一画素電極に設けられた第一非線型抵抗素子の面積をS_{NL1}、前記櫛歯状第二画素電極に設けられた第二非線型抵抗素子の面積をS_{NL2}、としたとき、

$S_{LC1}=S_{LC2}$、　$S_{NL1}<S_{NL2}$

を満たす事を特徴とする請求項４５請求項４６又は請求項４７記載の液晶表示装置。

【請求項５１】　前記櫛歯状第一画素電極面積S_{LC1}の前記櫛歯状第一画素電極と前記櫛歯状第二画素電極を合わせた面積$S_{LC1}+S_{LC2}$に対する比をκ_1としたとき、

$\kappa_1=S_{LC1}/(S_{LC1}+S_{LC2})$

κ_1の値が０．１から０．９の間に有る事を特徴とする請求項４８記載の液晶表示装置。

【請求項５２】　前記櫛歯状第一画素電極の面積をS_{LC1}、前記櫛歯状第二画素電極の面積をS_{LC2}、前記櫛歯状第一画素電極に設けられた非線型抵抗素子の面積をS_{NL1}、前記櫛歯状第二画素電極に設けられた非線型抵抗素子の面積をS_{NL2}、としたとき、

$S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$

を満たす事を特徴とする請求項４５請求項４６又は請求項４７記載の液晶表示装置。

【請求項５３】　前記第一スイッチング素子及び前記第二スイッチング素子は其々導電体－絶縁体－導電体を順次積層した構造を有する第一非線型抵抗素子と第二非線型抵抗素子から成り、

其々の非線型抵抗素子容量をC_{NL1}、C_{NL2}とし、前記櫛歯状第一画素電極で駆動される液晶層の容量をC_{LC1}、前記櫛歯状第二画素電極で駆動される液晶層の容量をC_{LC2}とし、

$C_{LC1}/C_{NL1}=m_2(C_{LC2}/C_{NL2})$

上式にて係数m_2を定義したとき、

m_2の値の範囲が０．００１から０．９９９の間で有る事を特徴とする請求項４５、又は請求項４６、請求項４７記載の液晶表示装置。

【請求項５４】　前記櫛歯状第一画素電極の面積をS_{LC1}、前記櫛歯状第二画素電極の面積をS_{LC2}、前記櫛歯状第一画素電極に設けられた第一非線型抵抗素子の面積をS_{NL1}、前記櫛歯状第二画素電極に設けられた第二非線型抵抗素子の面積をS_{NL2}、としたとき、

$S_{LC1}=S_{LC2}$、かつ、　$S_{NL1}>S_{NL2}$

を満たす事を特徴とする請求項４５、請求項４６又は請求項４７記載の液晶表示装置。

【請求項５５】　前記櫛歯状第二画素電極面積S_{LC2}の前記櫛歯状第一画素電極と前記櫛歯状第二画素電極とを合わせた面積$S_{LC1}+S_{LC2}$に対する比をκ_2としたとき、

$\kappa_2=S_{LC2}/(S_{LC1}+S_{LC2})$

κ_2の値が０．１から０．９の間に有る事を特徴とする請求項５２記載の液晶表示装置。

【請求項５６】　第１導電体－絶縁体－第２導電体を順次積層した構造を有する非線型抵抗素子と、液晶を駆動する液晶駆動電極と、を含んで構成される液晶表示装置において、

前記液晶駆動電極が第一画素電極と第二画素電極に分割され、

前記第一画素電極を駆動する第一非線型抵抗素子の電気的非線型特性と、前記第二画素電極を駆動する第二非線型抵抗素子の電気的非線型特性と、が異なる事を特徴とする液晶表示装置。

【請求項５７】　第１導電体－絶縁体－第２導電体を順次積層した構造を有する非線型抵抗素子と、液晶を駆動する液晶駆動電極と、を含んで構成される液晶表示装置において、

前記液晶駆動電極が第一画素電極と第二画素電極に分割され、

前記第一画素電極を駆動する第一非線型抵抗素子の絶縁膜の厚さと、前記第二画素電極を駆動する第二非線型抵抗素子の絶縁膜の厚さと、が異なる事を特徴とする液晶表示装置。

【請求項５８】　前記第二画素電極が前記第一画素電極を取り囲む様に形成されている事を特徴とする請求項５６又は請求項５７記載の液晶表示装置。

【請求項５９】　前記第一非線型抵抗素子の第１導電体と、前記第二非線型抵抗素子の第１導電体とが、液晶表示装置の表示領域の外部で電気的に接続された事を特徴とする請求項５６請求項５７又は請求項５８記載の液晶表示装置。

【請求項６０】　導電体－絶縁体－導電体を順次積層した構造を有する非線型抵抗素子と、液晶を駆動する液晶駆動電極と、を含んで構成される液晶表示装置において、

前記液晶駆動電極が第一画素電極と第二画素電極に分割され、前記第一画素電極を駆動する第一非線型抵抗素子と、前記第一画素電極と前記第二画素電極が直列に接続される様に第二非線型抵抗素子及び第三非線型抵抗素子を設けた事を特徴とする液晶表示装置。

【請求項６１】　非線型抵抗素子が、タンタルを一成分とする金属、タンタルを一成分とする金属の酸化物、金属あるいは透明導電膜を順次積層した構造を取る事を特徴とする請求項１乃至請求項６０のいずれかに記載の液晶表示装置。

【請求項６２】　非線型抵抗素子の絶縁体が窒化ケイ素である事を特徴とする請求項１乃至請求項６０のいずれかに記載の液晶表示装置。

【請求項６３】　前記スイッチング素子は薄膜トランジスタで有る事を特徴とする請求項４４記載の液晶表示装置。

【請求項６４】　液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極と、該液晶駆動電極に接続された薄膜トランジスタと、で構成される液晶表示装置において、

前記液晶駆動電極が第一画素電極と第二画素電極に分割されて居り、

前記第一画素電極には第一薄膜トランジスタが接続され、

前記第二画素電極には第二薄膜トランジスタが接続され、

前記第一薄膜トランジスタのゲート電極は第一走査線に接続されて居り、

前記第二薄膜トランジスタのゲート電極は第二走査線に接続されて居り、

前記第一薄膜トランジスタと前記第二薄膜トランジスタとは互いに逆導電タイプで有る事を特徴とする液晶表示装置。

【請求項６５】　前記第一画素電極及び前記第二画素電極は櫛歯状で、互いに噛合って居る事を特徴とする請求項６４記載の液晶表示装置。

【請求項６６】　前記第一画素電極の面積と前記第二画素電極との面積が等しい事を特徴とする請求項６４又は請求項６５記載の液晶表示装置。

【請求項６７】　前記第一薄膜トランジスタはＮ型導電タイプで有り、

前記第二薄膜トランジスタはＰ型導電タイプで有り、

前記第一薄膜トランジスタが接続した第一画素電極の面積は前記第二薄膜トランジスタが接続した第二画素電極の面積よりも大きい事を特徴とする請求項６４記載の液晶表示装置。

【請求項６８】　前記第一画素電極及び前記第二画素電極は櫛歯状で、互いに噛合って居る事を特徴とする請求項６７記載の液晶表示装置。

【請求項６９】　液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極と、該液晶駆動電極に接続された薄膜トランジスタと、で構成される液晶表示装置において、

前記液晶駆動電極が第一画素電極と第二画素電極に分割されて居り、

前記第一画素電極にはＮ型導電タイプの第一薄膜トランジスタが接続され、

前記第二画素電極にはＰ型導電タイプの第二薄膜トランジスタが接続され、

前記第一薄膜トランジスタのゲート電極は第一走査線に接続されて居り、
前記第二薄膜トランジスタのゲート電極は第二走査線に接続されて居り、
前記第一薄膜トランジスタのチャンネル長をL_1、チャンネル幅をW_1、とし、前記第二薄膜トランジスタのチャンネル長をL_2、チャンネル幅をW_2、としたとき、
$W_1/L_1<W_2/L_2$
との関係式を満たす事を特徴とする液晶表示装置。

【請求項７０】　液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極と、該液晶駆動電極に接続された薄膜トランジスタと、で構成される液晶表示装置において、
前記液晶駆動電極が第一画素電極と第二画素電極に分割されて居り、
前記第一画素電極にはN型導電タイプの第一薄膜トランジスタが接続され、
前記第二画素電極にはP型導電タイプの第二薄膜トランジスタが接続され、
前記第一薄膜トランジスタのゲート電極は第一走査線に接続されて居り、
前記第二薄膜トランジスタのゲート電極は第二走査線に接続されて居り、
前記第一薄膜トランジスタのチャンネル長は前記第二薄膜トランジスタのチャンネル長より長い事を特徴とする液晶表示装置。

【請求項７１】　液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極と、該液晶駆動電極に接続された薄膜トランジスタと、で構成される液晶表示装置において、
前記液晶駆動電極が第一画素電極と第二画素電極に分割されて居り、
前記第一画素電極にはN型導電タイプの第一薄膜トランジスタが接続され、
前記第二画素電極にはP型導電タイプの第二薄膜トランジスタが接続され、
前記第一薄膜トランジスタのゲート電極は第一走査線に接続されて居り、
前記第二薄膜トランジスタのゲート電極は第二走査線に接続されて居り、
前記第一薄膜トランジスタのチャンネル幅は前記第二薄膜トランジスタのチャンネル幅よりも狭い事を特徴とする液晶表示装置。

【請求項７２】　前記第一画素電極及び前記第二画素電極は櫛歯状で、互いに嚙合って居る事を特徴とする請求項６９、請求項７０又は請求項７１記載の液晶表示装置。

【請求項７３】　前記第一画素電極の面積と前記第二画素電極の面積が等しい事を特徴とする請求項６９乃至請求項７２のいずれかに記載の液晶表示装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、導電体－絶縁体－導電体を順次積層した構造を有する非線型抵抗素子（以下ＭＩＭ素子と呼ぶ）や薄膜トランジスタ（以下ＴＦＴ素子と呼ぶ）等のスイッチング素子と液晶駆動電極とを含んで構成される液晶表示装置に関する。

【０００２】

【従来の技術】図２に従来のＭＩＭ素子を形成した液晶表示装置の１表示画素の構造を示す。（ａ）はこの従来の液晶表示装置の平面図であり、（ｂ）は断面図である。ここでＭＩＭ素子とは、例えばＴａ（タンタル）－タンタル酸化物（Ta_2O_5）－酸化インジウムスズ（ＩＴＯ）等のような第１導電体－絶縁体－第２導電体の３層構造で構成される非線型抵抗素子をいう。この場合、第２導電体としては、ＩＴＯに限らず、例えばＣｒ又はＣｒを成分とする合金を用いる事ができる。

【０００３】次に、この従来のＭＩＭ素子を形成した液晶表示装置の製造方法を説明する。

【０００４】まず、第１基板２０１上にスパッタ法によりＴａ膜が形成される。次に、このＴａ膜がフォトエッチングによりパターニングされ配線電極を兼ねたＭＩＭ素子２０８の第１導電体２０３が形成される。そして、陽極酸化法により第１導電体２０３の表面が酸化され、絶縁体２０４が形成される。次に、スパッタ法によりＩＴＯ膜が形成される。そして、このＩＴＯ膜はフォトエッチングによりパターニングされ、ＭＩＭ素子２０８の第２導電体を兼ねた液晶駆動電極２０５が形成される。第１基板２０１と対向する様に第２基板２０２を設ける。第２基板２０２には、スパッタ法によりＩＴＯ膜が形成される。そして、このＩＴＯ膜はフォトエッチングにより、ストライプ状にパターニングされたデータ線２０６が、第１基板２０１の配線電極と直交するように形成される。第１基板２０１と第２基板２０２の間には、液晶層２０７を充填して液晶表示装置が構成されている。この液晶表示装置でカラー表示を必要とする場合は、第２基板２０２とデータ線２０６の間、あるいはデータ線２０６と液晶層２０７の間にカラーフィルター層を設置する。

【０００５】またスイッチング素子としてＴＦＴ素子を用いた場合は第１基板２０１側に複数の走査線とこれら走査線と直交する様に複数のデータ線を設け、ＴＦＴ素子を走査線とデータ線の各交点に設置する。この際ＴＦＴ素子のゲート電極は走査線に接続され、ソース電極はデータ線に、液晶駆動電極はドレイン電極に接続される。第２基板２０２側には対向電極が設けられている。走査線に選択状態の電位が与えられたときにのみＴＦＴのソース・ドレイン間は低インピーダンスのオン状態と化し、データ線とオン状態のＴＦＴを通じて表示信号に対応する電位が液晶駆動電極に与えられ、第２基板２０

２側の対向電極と液晶駆動電極との間に挟持された液晶の光学状態を変化させる。ＴＦＴに制御される液晶駆動電極はマトリクス状に配置されており、これにより情報の表示が可能となる。

【０００６】

【発明が解決しようとする課題】さて近年、この種の液晶表示装置は、例えばノート型パソコン、ワークステーション、液晶ＴＶ等に利用されるようになっている。従って、液晶表示装置のサイズも対角２２．９ｃｍ～２５．４ｃｍ以上と非常に大面積化しているのが現状である。かかる現状において、前述した従来のＭＩＭ素子を用いた液晶表示装置では、以下の問題点が生じていた。

【０００７】従来の液晶表示装置では、配線電極を兼ねた第１導電体２０３に走査信号を、ＩＴＯ配線２０６にデータ信号を印加し、時分割駆動により液晶層２０７へ印加する電界強度を制御し、液晶の配向状態を変えて情報を表示する。この際液晶駆動電極２０５とＩＴＯ配線２０６に挟まれた液晶層には均一な電界が印加されてしまい、液晶表示装置の視角特性が悪化するという問題が生じていた。特に対角２２．９ｃｍ～２５．４ｃｍ以上の大面積液晶表示装置では、少しでも視角を変えて液晶表示装置を見るとコントラストの低下、中間調の反転等が生じ、間違った情報が表示されてしまった。

【０００８】このような視角特性を改善する技術として、例えば、ＳＩＤ’９１，ＤＩＧＥＳＴ，Ｐ５５５～５５７やＳＩＤ’９２，ＤＩＧＥＳＴ，Ｐ７９８～８０１に記載された従来技術がある。

【０００９】第一の従来技術（ＳＩＤ’９１，Ｐ，５５５～５５７）は液晶駆動電極を２分割し、この分割された２つの液晶駆動電極を容量結合し、これを１つの薄膜トランジスタで駆動している。この結果、１画素の中で液晶層に印加される実効電圧が２種類となり視覚特性が向上するものであった。しかし、分割した２つの液晶駆動電極を容量結合するために構造が複雑となってしまうという問題点が生じている。

【００１０】一方第二の従来技術（ＳＩＤ’９２，Ｐ，７９８～８０１）は１つの液晶駆動電極上に形成する液晶配向膜を分割して形成し、液晶のプレイチルト角が大きい領域と小さい領域を設け、視角特性を向上させるものであった。しかし、液晶の配向膜の形成方法がきわめて複雑となってしまうとの問題点が生じている。

【００１１】更に第３の従来技術としては特開平５－５３１５０に示される手法がある。これを図１６を用いて説明する。この従来技術ではマトリックス状に配置された１つの液晶駆動電極を複数個の画素電極に分割し、各々の画素電極にＭＩＭ素子を設け、各画素電極の面積とＭＩＭ素子面積比を変えている。図１６の例では第２基板に設けられたストライプ状の対向電極１７０１と第１基板に設けられた配線１７０２にて定められている領域の第１基板上に液晶駆動電極とＭＩＭ素子が設けられている。液晶駆動電極は第一画素電極１７０３と第二画素電極１７０４に二分割され、第一画素電極１７０３には第一ＭＩＭ素子１７０５が接続され、第二画素電極１７０４には第二ＭＩＭ素子１７０６が接続されている。第一画素電極の面積と第一ＭＩＭ素子の面積との比を第二画素電極の面積と第二ＭＩＭ素子の面積との比と異ならせる事により視角特性を改善している。しかしながらこの第三の従来技術では液晶駆動電極の分割方法や画素電極面積に何の配慮もなされていなかった為に視角特性は十分に改善されていないとの問題点が有った。又、第一画素電極１７０３と第二画素電極１７０４との分離距離ｄに対する考慮がなされていないが故この分離領域と対向電極に挟まれた液晶が制御されずコントラストの低下を招いたり、ノーマリ白表示モード（液晶に電圧を印加しない状態で光が透過する表示方法）で黒表示を行うときに分離領域から光漏れが生ずるとの問題点があった。

【００１２】本発明は以上の様な問題点を解決するものでその目的とするところは、構造を複雑にする事なく、液晶に印加する実効電圧を制御して視角特性を向上し、表示品質の高い液晶表示装置を実現する事にある。

【００１３】本発明の別の目的は又以下に示すがごとき課題を解決する事にもある。即ち、スイッチング素子にＭＩＭ素子を用いる場合もＴＦＴ素子を用いる場合のいずれにしても液晶表示装置には数十万から数百万個の液晶駆動電極とそれに対応するスイッチング素子が設けられている。これら膨大な数に昇るスイッチング素子の一つでも不良が生ずるとそのスイッチング素子はスイッチング素子としての機能を果たせず、不良スイッチング素子が接続した液晶駆動電極には表示すべき情報に正しく相応する電位が与えられない。この結果不良スイッチング素子が接続した液晶駆動電極は液晶表示装置に於いて点欠陥として視認されるに至る。この点欠陥を補修する最も簡便な一従来技術として前述の図１６の手法が知られている。これは一つの液晶駆動電極を複数の画素電極に分割し、（図１６では第一画素電極１７０３と第二画素電極１７０４）それぞれの画素電極にはそれぞれのスイッチング素子（図１６では第一ＭＩＭ素子１７０５と第二ＭＩＭ素子１７０６）を設ける物である。スイッチング素子が全て良品で有れば分割された複数の画素電極には殆ど同じ電位が供与され、これら複数の画素電極から構成される一つの液晶駆動電極は正常に動作する。仮令複数のスイッチング素子の内の一つが不良であっても（例えば図１６で第一ＭＩＭ素子１７０５が不良とすると）、他のスイッチング素子も同時に不良になる確率は非常に小さいから一つの液晶駆動電極は残った他の正常なスイッチング素子（先の例では第二ＭＩＭ素子１７０６）を介して正しい電位が画素電極（先の例では第二画素電極１７０４）に供与されて動作する為、点欠陥には至らないのである。しかしながらこの手法では点欠陥の補修能力が十分でないとの課題が有る。例えば図１６に

示す液晶表示装置を液晶に電界を掛けぬときに光が透過するノーマリ白表示モードで動作させる場合を考えるとこの課題は明瞭と化す。今第一ＭＩＭ素子１７０５が不良で第一画素電極１７０３には全く電位が与えられないとする。このときに黒表示を行うと第二ＭＩＭ素子１７０６を介して第二画素電極１７０４には正常な電位が供与され、第二画素電極１７０４と対向電極１７０１に挟まれた液晶は正しく光学状態を変え黒表示となる。所が不良ＭＩＭ素子に接続した第一画素電極１７０３と対向電極１７０１に挟まれた液晶には電界が掛からず、この領域は光が透過してしまう。液晶表示装置の画面全体を黒表示した場合、これらの画素領域は夜空に瞬く星の様に視認されるので有る。ここで想定している状況は点欠陥が最も目立つ場合で有るが、他の表示モードや素子不良モードに於いてもコントラストが正常時に比べて著しく劣るとの形態で本質的に同じ課題が生ずる訳で有る。換言するならば従来の簡便な欠陥補修技術は十分に欠陥を補修出来ていないので有る。ここではスイッチング素子の例としてＭＩＭ素子を用いて説明したが全く同じ事情はＴＦＴ素子をスイッチング素子として用いた液晶表示装置に対しても当てはまっている。そこで本発明の別な目的は上述のごとき課題を解決する物で、構造や製造工程を複雑にする事なく、点欠陥を簡便且つ十分に補修し得る液晶表示装置を提供する事に有る。

【００１４】

【課題を解決するための手段】前記目的を達成するために本発明に係わる液晶表示装置は、非線型抵抗素子と、液晶を駆動する液晶駆動電極とを含んで構成される液晶表示装置において、前記液晶駆動電極が、第一画素電極と、前記第一画素電極の周辺部に形成された第二画素電極で構成され、前記第一画素電極と前記第二画素電極をそれぞれ駆動する第一非線型抵抗素子と、第二非線型抵抗素子を設けた事を特徴とする。斯様な液晶表示装置は、前記第一非線型抵抗素子と前記第二非線型抵抗素子は、導電体－絶縁体－導電体を順次積層した構造を有し、それぞれの非線型抵抗素子面積をS_{NL1}、S_{NL2}とし、前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}としたとき、

$S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$

を満たす事を特徴とする。或いは、前記第一非線型抵抗素子と前記第二非線型抵抗素子は、導電体－絶縁体－導電体を順次積層した構造を有し、それぞれの非線型抵抗素子容量をC_{NL1}、C_{NL2}とし、前記第一画素電極で駆動される液晶層の容量をC_{LC1}、前記第二画素電極で駆動される液晶層の容量をC_{LC2}とし、

$C_{LC2}/C_{NL2}=m_1(C_{LC1}/C_{NL1})$

上式にて係数m_1を定義したとき、m_1の値の範囲が０．００１から０．９９９の間で有る事を特徴とする。或いは、前記第一非線型抵抗素子と前記第二非線型抵抗素子は、導電体－絶縁体－導電体を順次積層した構造を有し、それぞれの非線型抵抗素子面積をS_{NL1}、S_{NL2}とし、前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}としたとき、

$S_{LC1}=S_{LC2}$、　$S_{NL1}<S_{NL2}$

を満たす事を特徴とする。更には、前記第一画素電極面積S_{LC1}の前記第一画素電極と前記第二画素電極を合わせた面積$S_{LC1}+S_{LC2}$に対する比をκ_1としたとき、

$\kappa_1=S_{LC1}/(S_{LC1}+S_{LC2})$

κ_1の値が０．１から０．９の間に有る事を特徴とする。或いは、前記第一非線型抵抗素子と前記第二非線型抵抗素子は、導電体－絶縁体－導電体を順次積層した構造を有し、それぞれの非線型抵抗素子面積をS_{NL1}、S_{NL2}とし、前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}としたとき、

$S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$

を満たす事を特徴とする。或いは、前記第一非線型抵抗素子と前記第二非線型抵抗素子は、導電体－絶縁体－導電体を順次積層した構造を有し、それぞれの非線型抵抗素子容量をC_{NL1}、C_{NL2}とし、前記第一画素電極で駆動される液晶層の容量をC_{LC1}、前記第二画素電極で駆動される液晶層の容量をC_{LC2}とし、

$C_{LC1}/C_{NL1}=m_2(C_{LC2}/C_{NL2})$

上式にて係数m_2を定義したとき、m_2の値の範囲が０．００１から０．９９９の間で有る事を特徴とする。或いは、前記第一非線型抵抗素子と前記第二非線型抵抗素子は、導電体－絶縁体－導電体を順次積層した構造を有し、それぞれの非線型抵抗素子面積をS_{NL1}、S_{NL2}とし、前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}としたとき、

$S_{LC1}=S_{LC2}$、　$S_{NL1}>S_{NL2}$

を満たす事を特徴とする。更には、前記第二画素電極面積S_{LC2}の第一画素電極と第二画素電極を合わせた面積$S_{LC1}+S_{LC2}$に対する比をκ_2としたとき、

$\kappa_2=S_{LC2}/(S_{LC1}+S_{LC2})$

κ_2の値が０．１から０．９の間に有る事を特徴とする。

【００１５】又本発明に係わる液晶表示装置は、液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極を構成要素の一つとする液晶表示装置において、前記液晶駆動電極の夫々が複数個の画素電極に分割され、該画素電極間の分離距離ｄが１０μｍ以下である事を特徴とする。

【００１６】又本発明に係わる液晶表示装置は、液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極と、導電体－絶縁体－導電体を順次積層した構造を有する非線型抵抗素子とを含んで構成される液晶表示装置において、前記液晶駆動電極が前記液晶表示装置の広視野角が求められる方向にｎ個（ｎ≧２の整数）の画素電極に分割され、該画素電極の其れぞれには非線型抵抗素子が設けられてをり、ｉ番目（ｉは１からｎの間

の任意の整数）の画素電極の面積S_{LCi}とし、ｉ番目の画素電極に設けられた非線型抵抗素子の面積をS_{NLi}としたとき、ｎ個のS_{LCi}/S_{NLi}の値が少なくとも２種類以上である事を特徴とする。斯様な液晶表示装置は、前記液晶駆動電極が前記液晶表示装置の水平方向にｎ個（ｎ≧２の整数）の画素電極に分割されている事を特徴とする。或いは、前記液晶駆動電極が前記液晶表示装置の垂直方向にｎ個（ｎ≧２の整数）の画素電極に分割されている事を特徴とする。或いは、前記ｉ番目のS_{LCi}/S_{NLi}の値とｎ＋１－ｉ番目の$S_{LC(n+1-i)}/S_{NL(n+1-i)}$の値が等しい事を特徴とする。或いは、前記液晶駆動電極が３分割された事を特徴とする。

【００１７】又本発明に係わる液晶表示装置は、液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極と、導電体－絶縁体－導電体を順次積層した構造を有する非線型抵抗素子とを含んで構成される液晶表示装置において、前記液晶駆動電極が第一画素電極と第二画素電極に分割されて居り、前記第二画素電極は前記第一画素電極を囲い、且つ前記第二画素電極の一部は前記第一画素電極の内側に延在されて居る事を特徴とする。斯様な液晶表示装置は、前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}、前記第一画素電極に設けられた非線型抵抗素子の面積をS_{NL1}、前記第二画素電極に設けられた非線型抵抗素子の面積をS_{NL2}としたとき、

$S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$

を満たす事を特徴とする。或いは、前記第一非線型抵抗素子と前記第二非線型抵抗素子は、導電体－絶縁体－導電体を順次積層した構造を有し、それぞれの非線型抵抗素子容量をC_{NL1}、C_{NL2}とし、前記第一画素電極で駆動される液晶層の容量をC_{LC1}、前記第二画素電極で駆動される液晶層の容量をC_{LC2}とし、

$C_{LC2}/C_{NL2}=m_1(C_{LC1}/C_{NL1})$

上式にて係数m_1を定義したとき、m_1の値の範囲が０．００１から０．９９９の間で有る事を特徴とする。或いは、前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}、前記第一画素電極に設けられた非線型抵抗素子の面積をS_{NL1}、前記第二画素電極に設けられた非線型抵抗素子の面積をS_{NL2}としたとき、

$S_{LC1}=S_{LC2}$、　$S_{NL1}<S_{NL2}$

を満たす事を特徴とする。或いは、前記第一画素電極面積S_{LC1}の前記第一画素電極と前記第二画素電極を合わせた面積$S_{LC1}+S_{LC2}$に対する比をκ_1としたとき、

$\kappa_1=S_{LC1}/(S_{LC1}+S_{LC2})$

κ_1の値が０．０５から０．８の間に有る事を特徴とする。或いは、前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}、前記第一画素電極に設けられた非線型抵抗素子の面積をS_{NL1}、前記第二画素電極に設けられた非線型抵抗素子の面積をS_{NL2}としたとき、

$S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$

を満たす事を特徴とする。或いは、前記第一非線型抵抗素子と前記第二非線型抵抗素子は、導電体－絶縁体－導電体を順次積層した構造を有し、それぞれの非線型抵抗素子容量をC_{NL1}、C_{NL2}とし、前記第一画素電極で駆動される液晶層の容量をC_{LC1}、前記第二画素電極で駆動される液晶層の容量をC_{LC2}とし、

$C_{LC1}/C_{NL1}=m_2(C_{LC2}/C_{NL2})$

上式にて係数m_2を定義したとき、m_2の値の範囲が０．００１から０．９９９の間で有る事を特徴とする。或いは、前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}、前記第一画素電極に設けられた非線型抵抗素子の面積をS_{NL1}、前記第二画素電極に設けられた非線型抵抗素子の面積をS_{NL2}としたとき、

$S_{LC1}=S_{LC2}$、　$S_{NL1}>S_{NL2}$

を満たす事を特徴とする。或いは、前記第二画素電極面積S_{LC2}の第一画素電極と第二画素電極を合わせた面積$S_{LC1}+S_{LC2}$に対する比をκ_2としたとき、

$\kappa_2=S_{LC2}/(S_{LC1}+S_{LC2})$

κ_2の値が０．２から０．９５の間に有る事を特徴とする。

【００１８】又本発明に係わる液晶表示装置は、液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極と、導電体－絶縁体－導電体を順次積層した構造を有する非線型抵抗素子とを含んで構成される液晶表示装置において、前記液晶駆動電極が第一画素電極と第二画素電極に分割されて居り、前記第二画素電極は前記第一画素電極を囲い、且つ前記第二画素電極の一部は前記第一画素電極の内側に延在されて居り、更に前記第一画素電極の一部は前記第二画素電極の内側に延在されて居る事を特徴とする。斯様な液晶表示装置は、前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}、前記第一画素電極に設けられた非線型抵抗素子の面積をS_{NL1}、前記第二画素電極に設けられた非線型抵抗素子の面積をS_{NL2}としたとき、

$S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$

を満たす事を特徴とする。或いは、前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}、前記第一画素電極に設けられた非線型抵抗素子の面積をS_{NL1}、前記第二画素電極に設けられた非線型抵抗素子の面積をS_{NL2}としたとき、

$S_{LC1}=S_{LC2}$、　$S_{NL1}<S_{NL2}$

を満たす事を特徴とする。或いは、前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}、前記第一画素電極に設けられた非線型抵抗素子の面積をS_{NL1}、前記第二画素電極に設けられた非線型抵抗素子の面積をS_{NL2}としたとき、

$S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$

を満たす事を特徴とする。或いは、前記第一画素電極の面積をS_{LC1}、前記第二画素電極の面積をS_{LC2}、前記第

一画素電極に設けられた非線型抵抗素子の面積をS_{NL1}、前記第二画素電極に設けられた非線型抵抗素子の面積をS_{NL2}としたとき、

$S_{LC1}=S_{LC2}$、　$S_{NL1}>S_{NL2}$

を満たす事を特徴とする。

【0019】又本発明に係わる液晶表示装置は、液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極と、導電体－絶縁体－導電体を順次積層した構造を有する非線型抵抗素子とを含んで構成される液晶表示装置において、前記液晶駆動電極がn個（n≧2の整数）の同心状画素電極に分割され、該同心状画素電極の其れぞれには非線型抵抗素子が設けられて居る事を特徴とする。斯様な液晶表示装置は、前記同心状画素電極のi番目（iは1からnの間の任意の整数）の同心状画素電極の面積S_{LCi}とし、i番目の同心状画素電極に設けられた非線型抵抗素子の面積をS_{NLi}としたとき、n個のS_{LCi}/S_{NLi}の値が少なくとも２種類以上である事を特徴とする。

【0020】又本発明に係わる液晶表示装置は、液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極と、該液晶駆動電極に接続されたスイッチング素子とで構成される液晶表示装置において、前記液晶駆動電極が櫛歯状第一画素電極と櫛歯状第二画素電極に分割されて居り、前記櫛歯状第一画素電極には第一スイッチング素子が接続され、前記櫛歯状第二画素電極には第二スイッチング素子が接続され、前記櫛歯状第一画素電極と前記櫛歯状第二画素電極は互いに噛合って居る事を特徴とする。

【0021】又本発明に係わる液晶表示装置は、液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極と、該液晶駆動電極に接続されたスイッチング素子とで構成される液晶表示装置において、前記液晶駆動電極が櫛歯状第一画素電極と櫛歯状第二画素電極に分割されて居り、前記櫛歯状第一画素電極には第一スイッチング素子が接続され、前記櫛歯状第二画素電極には第二スイッチング素子が接続され、前記櫛歯状第一画素電極と前記櫛歯状第二画素電極は互いに噛合って居り、前記スイッチング素子は導電体－絶縁体－導電体を順次積層した構造を有する非線型抵抗素子で有る事を特徴とする。斯様な液晶表示装置は、前記櫛歯状第一画素電極と前記櫛歯状第二画素電極は水平方向に互いに噛合って居る事を特徴とする。或いは、前記櫛歯状第一画素電極と前記櫛歯状第二画素電極は垂直方向に互いに噛合って居る事を特徴とする。更には、前記櫛歯状第一画素電極の面積をS_{LC1}、前記櫛歯状第二画素電極の面積をS_{LC2}、前記櫛歯状第一画素電極に設けられた非線型抵抗素子の面積をS_{NL1}、前記櫛歯状第二画素電極に設けられた非線型抵抗素子の面積をS_{NL2}としたとき、

$S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$

を満たす事を特徴とする。或いは、前記櫛歯状第一画素電極の面積をS_{LC1}、前記櫛歯状第二画素電極の面積をS_{LC2}、前記櫛歯状第一画素電極に設けられた非線型抵抗素子の面積をS_{NL1}、前記櫛歯状第二画素電極に設けられた非線型抵抗素子の面積をS_{NL2}としたとき、

$S_{LC1}=S_{LC2}$、　$S_{NL1}<S_{NL2}$

を満たす事を特徴とする。或いは、前記櫛歯状第一画素電極の面積をS_{LC1}、前記櫛歯状第二画素電極の面積をS_{LC2}、前記櫛歯状第一画素電極に設けられた非線型抵抗素子の面積をS_{NL1}、前記櫛歯状第二画素電極に設けられた非線型抵抗素子の面積をS_{NL2}としたとき、

$S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$

を満たす事を特徴とする。或いは、前記櫛歯状第一画素電極の面積をS_{LC1}、前記櫛歯状第二画素電極の面積をS_{LC2}、前記櫛歯状第一画素電極に設けられた非線型抵抗素子の面積をS_{NL1}、前記櫛歯状第二画素電極に設けられた非線型抵抗素子の面積をS_{NL2}としたとき、

$S_{LC1}=S_{LC2}$、　$S_{NL1}>S_{NL2}$

を満たす事を特徴とする。

【0022】又本発明に係わる液晶表示装置は、液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極と、該液晶駆動電極に接続されたスイッチング素子とで構成される液晶表示装置において、前記液晶駆動電極が櫛歯状第一画素電極と櫛歯状第二画素電極に分割されて居り、前記櫛歯状第一画素電極には第一スイッチング素子が接続され、前記櫛歯状第二画素電極には第二スイッチング素子が接続され、前記櫛歯状第一画素電極と前記櫛歯状第二画素電極は互いに噛合って居り、前記スイッチング素子は薄膜トランジスタで有る事を特徴とする。

【0023】又本発明に係わる液晶表示装置は、液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極と、該液晶駆動電極に接続された薄膜トランジスタとで構成される液晶表示装置において、前記液晶駆動電極が第一画素電極と第二画素電極に分割されて居り、前記第一画素電極には第一薄膜トランジスタが接続され、前記第二画素電極には第二薄膜トランジスタが接続され、前記第一薄膜トランジスタのゲート電極は第一走査線に接続されて居り、前記第二薄膜トランジスタのゲート電極は第二走査線に接続されて居り、前記第一薄膜トランジスタと前記第二薄膜トランジスタは互いに逆導電タイプで有る事を特徴とする。斯様な液晶表示装置は、前記第一画素電極及び前記第二画素電極は櫛歯状で、互いに噛合って居る事を特徴とする。更には、前記第一画素電極の面積と前記第二画素電極の面積が等しい事を特徴とする。

【0024】又本発明に係わる液晶表示装置は、液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極と、該液晶駆動電極に接続された薄膜トランジスタとで構成される液晶表示装置において、前記液晶駆動電極が第一画素電極と第二画素電極に分割されて居

り、前記第一画素電極には第一薄膜トランジスタが接続され、前記第二画素電極には第二薄膜トランジスタが接続され、前記第一薄膜トランジスタのゲート電極は第一走査線に接続されて居り、前記第二薄膜トランジスタのゲート電極は第二走査線に接続されて居り、前記第一薄膜トランジスタはＮ型導電タイプで有り、前記第二薄膜トランジスタはＰ型導電タイプで有り、前記第一薄膜トランジスタが接続した第一画素電極の面積は前記第二薄膜トランジスタが接続した第二画素電極の面積よりも大きい事を特徴とする。斯様な液晶表示装置は、前記第一画素電極及び前記第二画素電極は櫛歯状で、互いに嚙合って居る事を特徴とする。

【００２５】又本発明に係わる液晶表示装置は、液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極と、該液晶駆動電極に接続された薄膜トランジスタとで構成される液晶表示装置において、前記液晶駆動電極が第一画素電極と第二画素電極に分割されて居り、前記第一画素電極にはＮ型導電タイプの第一薄膜トランジスタが接続され、前記第二画素電極にはＰ型導電タイプの第二薄膜トランジスタが接続され、前記第一薄膜トランジスタのゲート電極は第一走査線に接続されて居り、前記第二薄膜トランジスタのゲート電極は第二走査線に接続されて居り、前記第一薄膜トランジスタのチャンネル長をL_1、チャンネル幅をW_1とし、前記第二薄膜トランジスタのチャンネル長をL_2、チャンネル幅をW_2としたとき、

$$W_1/L_1<W_2/L_2$$

との関係式を満たす事を特徴とする。斯様な液晶表示装置は、前記第一画素電極及び前記第二画素電極は櫛歯状で、互いに嚙合って居る事を特徴とする。更には、前記第一画素電極の面積と前記第二画素電極の面積が等しい事を特徴とする。

【００２６】又本発明に係わる液晶表示装置は、液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極と、該液晶駆動電極に接続された薄膜トランジスタとで構成される液晶表示装置において、前記液晶駆動電極が第一画素電極と第二画素電極に分割されて居り、前記第一画素電極にはＮ型導電タイプの第一薄膜トランジスタが接続され、前記第二画素電極にはＰ型導電タイプの第二薄膜トランジスタが接続され、前記第一薄膜トランジスタのゲート電極は第一走査線に接続されて居り、前記第二薄膜トランジスタのゲート電極は第二走査線に接続されて居り、前記第一薄膜トランジスタのチャンネル長は前記第二薄膜トランジスタのチャンネル長より長い事を特徴とする。斯様な液晶表示装置は、前記第一画素電極及び前記第二画素電極は櫛歯状で、互いに嚙合って居る事を特徴とする。更には、前記第一画素電極の面積と前記第二画素電極の面積が等しい事を特徴とする。

【００２７】又本発明に係わる液晶表示装置は、液晶を駆動する為にマトリックス状に形成された複数個の液晶駆動電極と、該液晶駆動電極に接続された薄膜トランジスタとで構成される液晶表示装置において、前記液晶駆動電極が第一画素電極と第二画素電極に分割されて居り、前記第一画素電極にはＮ型導電タイプの第一薄膜トランジスタが接続され、前記第二画素電極にはＰ型導電タイプの第二薄膜トランジスタが接続され、前記第一薄膜トランジスタのゲート電極は第一走査線に接続されて居り、前記第二薄膜トランジスタのゲート電極は第二走査線に接続されて居り、前記第一薄膜トランジスタのチャンネル幅は前記第二薄膜トランジスタのチャンネル幅よりも狭い事を特徴とする。斯様な液晶表示装置は、前記第一画素電極及び前記第二画素電極は櫛歯状で、互いに嚙合って居る事を特徴とする。更には、前記第一画素電極の面積と前記第二画素電極の面積が等しい事を特徴とする。

【００２８】又本発明に係わる液晶表示装置は、第１導電体－絶縁体－第２導電体を順次積層した構造を有する非線型抵抗素子と、液晶を駆動する液晶駆動電極とを含んで構成される液晶表示装置において、前記液晶駆動電極が第一画素電極と第二画素電極に分割され、前記第一画素電極を駆動する第一非線型抵抗素子の電気的非線型特性と、前記第二画素電極を駆動する第二非線型抵抗素子の電気的非線型特性とが異なる事を特徴とする。或いは本発明に係わる液晶表示装置は、第１導電体－絶縁体－第２導電体を順次積層した構造を有する非線型抵抗素子と、液晶を駆動する液晶駆動電極とを含んで構成される液晶表示装置において、前記液晶駆動電極が第一画素電極と第二画素電極に分割され、前記第一画素電極を駆動する第一非線型抵抗素子の絶縁膜の厚さと、前記第二画素電極を駆動する第二非線型抵抗素子の絶縁膜の厚さが異なる事を特徴とする。斯様な液晶表示装置は、前記第一非線型抵抗素子の第１導電体と、前記第二非線型抵抗素子の第１導電体が、液晶表示装置の表示領域の外部で電気的に接続された事を特徴とする。或いは前記第二画素電極が前記第一画素電極を取り囲む様に形成されている事を特徴とする。

【００２９】又本発明に係わる液晶表示装置は、導電体－絶縁体－導電体を順次積層した構造を有する非線型抵抗素子と、液晶を駆動する液晶駆動電極とを含んで構成される液晶表示装置において、前記液晶駆動電極が第一画素電極と第二画素電極に分割され、前記第一画素電極を駆動する第一非線型抵抗素子と、前記第一画素電極と前記第二画素電極が直列に接続される様に第二非線型抵抗素子及び第三非線型抵抗素子を設けた事を特徴とする。

【００３０】又本発明に係わる液晶表示装置は、スイッチング素子として非線型抵抗素子が用いられる場合、それはタンタルを一成分とする金属、タンタルを一成分とする金属の酸化物、金属あるいは透明導電膜を順次積層

した構造を取る事を特徴とする。

【００３１】又本発明に係わる液晶表示装置は、スイッチング素子として非線型抵抗素子が用いられる場合、非線型抵抗素子の絶縁体が窒化ケイ素である事を特徴とする。

【００３２】

【発明の実施の形態】以下本発明を図面を用いて詳細に説明するが、それに先立ち各請求項が主として関わる実施例と図面の関係を記載しておく。但しこれは単に読者の便益を図る為の分類であり、或る発明が幾つかの実施例に関わる事も有れば、又後半の実施例では前半の実施例の繰り返しを避ける為に繰り返し部を省略している事もある。従って以下に記す分類はあくまで一つの目安に過ぎない。

【００３３】請求項１から１０の発明は主として実施例１及び図１に関わる。

【００３４】請求項１１から１５の発明は主として実施例２及び図３に関わる。

【００３５】請求項１６から２４の発明は主として実施例５及び図８、図９に関わる。

【００３６】請求項２５から３３の発明は主として実施例６及び図１０に関わる。

【００３７】請求項３４から４３の発明は主として実施例７及び図１１に関わる。

【００３８】請求項４４から５５の発明は主として実施例８及び図１２、図１３に関わる。

【００３９】請求項５６から５９の発明は主として実施例３及び図４、図５に関わる。

【００４０】請求項６０の発明は主として実施例４及び図６、図７に関わる。

【００４１】請求項６３から７３の発明は主として実施例９及び図１４、図１５に関わる。

【００４２】〔実施例１〕図１は本発明による実施例を示し、図１（ａ）は上視図、図１（ｂ）は図１（ａ）のＡＡ’における断面図である。

【００４３】ガラス等の第１基板１０１上にＴａをスパッタ法により形成し、フォトエッチングによりパターニングし、ＭＩＭ素子の第１導電体１０３を設ける。第１導電体１０３は、走査配線を兼ねた形状に加工し、例えばその膜厚は１０００～６０００Åとする。次に第１導電体１０３の表面を陽極酸化法により酸化し、ＭＩＭ素子の絶縁体１０４を２００～８００Åの膜厚となる様に形成する。例えば陽極酸化は０．０１～１％程度の濃度のクエン酸あるいは酒石酸アンモニウムの水溶液中に、陰極として白金を用い、陽極が第１導電体１０３となる様に配線し、１０～４５Ｖの直流を印加して、３０分～４時間酸化する。次に絶縁体１０４を３００～５００℃で焼成し、絶縁体１０４を緻密な膜にし、非線型特性を向上させる。次にＭＩＭ素子の第２導電体を兼ねた液晶駆動電極の第一画素電極１０５と第二画素電極１０６を形成する。第一画素電極１０５には第一ＭＩＭ素子１１１が接続され、第二画素電極１０６は第一画素電極１０５の周囲を囲む様に形成され、第二ＭＩＭ素子１１０が接続されている。第一画素電極１０５と第二画素電極１０６は例えばＩＴＯ（酸化インジウムスズ）に代表される透明導電体をスパッタ法により３００～４０００Åの厚さに成膜し、フォトエッチングによりパターニングする。ＭＩＭ素子の第２導電体と液晶駆動電極は一体で形成する必要はなく、例えば第２導電体としてＣｒやＮｉＣｒＴａ、Ｔｉ等の金属あるいは合金を用い、液晶駆動電極としてはＩＴＯ等の透明導電体を用いて、其々別々に形成してもよい。次に第１基板１０１と、液晶層１０９を介して対向する様に第２基板１０２を設ける。第２基板１０２には、ＩＴＯ等の透明導電体をストライプ状に加工したデータ線１０８を形成し、走査配線と直交する様に設ける。図１は簡単のためにモノクロ液晶表示装置について説明したが、染料により染色した有機層あるいは顔料を分散させた有機層を第２基板１０２とデータ線１０８の間、あるいはデータ線１０８と液晶層１０９の間、あるいは液晶駆動電極１０５、１０６と液晶層１０９の間、あるいは液晶駆動電極１０５、１０６と第１基板１０１の間のいずれかの位置に設置する事により容易にカラー液晶表示装置とする事ができる。

【００４４】従来技術と本実施例の大きな相違点は、液晶駆動電極を第一非線型抵抗素子の一種で有る第一画素電極１０５と第二非線型抵抗素子の一種で有る第二画素電極１０６の２つに分け、第一画素電極１０５の周辺部に第二画素電極１０６を形成し、更にそれぞれ独立した第一ＭＩＭ素子１１１と、第二ＭＩＭ素子１１０で駆動する事で液晶表示装置の視角特性を向上させた事である。

【００４５】Ｔｅｃｈ．Ｄｉｇ．ｏｆ　ｔｈｅ　Ｉｎｔ．Ｅｌｅｃｔｒｏｎ　Ｄｅｖｉｃｅｓ　Ｍｅｅｔｉｎｇ，ｐｐ．７０７－７１０　Ｄｅｃ．１９８０にＭＩＭ素子の容量C_{MIM}と液晶層の容量C_{LC}の比、C_{LC}/C_{MIM}が大きくなると液晶層に印加される実効電圧が大きくなる事が示されている。第一画素電極１０５で駆動される液晶層１１２の容量C_{LC1}と第一ＭＩＭ素子１１１の容量C_{NL1}の比と、第二画素電極１０６で駆動される液晶層１１３の容量C_{LC2}と第二ＭＩＭ素子１１０の容量C_{NL2}の比が異なる様にすれば、液晶層１１２と液晶層１１３に印加される実効電圧が変わり、視角特性が向上する。

【００４６】ここで第一ＭＩＭ素子１１１の面積をS_{NL1}、第二ＭＩＭ素子１１０の面積をS_{NL2}、絶縁体１０４の膜厚をt_{NL}、絶縁体１０４の比誘電率をε_{NL}、真空の誘電率をε_0とするとC_{NL1}、C_{NL2}はそれぞれ、

$C_{NL1}=\varepsilon_0\cdot\varepsilon_{NL}\cdot S_{NL1}/t_{NL}$…（１）

$C_{NL2}=\varepsilon_0\cdot\varepsilon_{NL}\cdot S_{NL2}/t_{NL}$…（２）

となる。一方第一画素電極１０５の面積をS_{LC1}、第二

画素電極１０６の面積をS_{LC2}、液晶層１１２、１１３の厚さ、すなわち第１基板１０１と第２基板１０２のギャップをt_{LC}、液晶の比誘電率をε_{LC}とするとC_{LC1}、C_{LC2}はそれぞれ

$C_{LC1}=\varepsilon_0\cdot\varepsilon_{LC}\cdot S_{LC1}/t_{LC}$…（３）

$C_{LC2}=\varepsilon_0\cdot\varepsilon_{LC}\cdot S_{LC2}/t_{LC}$…（４）

となる。

【００４７】１例として視角特性を向上させるために、

$C_{LC1}/C_{NL1}>C_{LC2}/C_{NL2}$…（５）

の関係を満たす様にすると、液晶層１１２に印加される実効電圧は、液晶層１１３に印加される実効電圧に比べ大きくなり、正面から見たときのコントラスト比は、液晶層１１２により十分に大きくなり、斜めから見たときのコントラスト比は、液晶層１１３により補償され、視野角の広い液晶表示装置となる。特に中間調表示の画面を斜めから見たときに、画面のネガポジ反転（白黒反転）を防止するのに大きな効果がある。式（５）に式（１）～（４）を代入して整理すると、

$S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$…（６）

となり、単に面積比を変えれば上記の効果が得られる事が分かる。これは従来技術に比べ、構造やプロセスを複雑にする事なく、単に液晶駆動電極をパターニングする際のフォトマスクを変更する事のみで実現できるので有る。加えて本実施例では第二画素電極１０６が完全に第一画素電極を囲んでいる為、どの方向から本実施例記載の液晶表示装置を見てもコントラスト比は液晶層１１３により補償され、視野角が広くなる。更に本実施例では欠陥補修が可能となっている。例えば第二ＭＩＭ素子１１０の絶縁膜１０４にピンホールがあって第一導電体１０３と第二画素電極１０６が短絡している場合、第二画素電極１０６の電位は常に走査配線の電位と同じになってしまうが、第一ＭＩＭ素子１１１も同時に不良でない限り正常に情報表示する第一画素電極１０５によりこの液晶駆動電極領域は点欠陥にはならないので有る。反対に第一ＭＩＭ素子１１１が不良で第一画素電極１０５が動作しない場合でも、第二ＭＩＭ素子１１０と第二画素電極１０６の正常動作によりこの液晶駆動電極領域は点欠陥にはならない。こうした欠陥補修との観点からは第一画素電極１０５の面積と第二画素電極１０６の面積が等しい事が好ましい。もし何方か一方の画素電極面積が他方の画素電極面積よりも著しく大きければ、大きい画素電極に接続するＭＩＭ素子が不良となったとき、生き残っている正常なＭＩＭ素子に接続する画素電極が著しく小さくなり、その為に欠陥補修が効果的に行われないからで有る。又液晶表示装置は多くの場合正面から眺める時間が長く、最適コントラストは正面に合わせられる。本実施例では第一画素電極１０５上の液晶層１１２が正面からの視点を作り、それらを囲む第二画素電極１０６上の液晶層１１３が上下、左右方向からの視野角を補償している。こうした点からも第一画素電極１０５と第二画素電極１０６の面積が等しい事が望まれる。この場合一つの液晶駆動電極の約５０％は正面からのコントラスト向上に寄与し、約２５％が左右方向の視野角を広げる事に寄与し、残りの約２５％が上下方向の視野角を広げる役割を演ずる事となる。無論本実施例で第一画素電極面積を広く取り、正面からのコントラストを優先させる事も可能で有る。反対に第一画素電極の面積を４０％程度と小さくし、第二画素電極の内で上下に走る帯部の面積を左右それぞれ２０％程度の計４０％程度とし、第二画素電極の内で左右に走る帯部の面積を上下それぞれ１０％程度の計２０％程度とすれば正面からのコントラストは多少劣るものの左右方向の視野角が著しく改善される。正面からの画質を重視する場合は第一画素電極の面積を比較的大きく取り、視野角を優先する場合は第二画素電極の面積を比較的大きくするので有る。しかしながら広視野角と高画質を両立し、更に効果的に欠陥補修できるとの観点からは第一画素電極面積S_{LC1}と第二画素電極面積S_{LC2}は等しい事が好ましい。

【００４８】$S_{LC1}=S_{LC2}$…（７）

このとき第一非線型抵抗素子で有る第一ＭＩＭ素子の面積S_{NL1}と第二非線型抵抗素子で有る第二ＭＩＭ素子の面積S_{NL2}の関係を

$S_{NL1}<S_{NL2}$…（８）

とすれば、

$S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$…（６）

の関係を満たし、上述の効果を実現できる。（６）式を満たした状態で、第一画素電極面積S_{LC1}の第一画素電極と第二画素電極を合わせた面積$S_{LC1}+S_{LC2}$に対する比をκ_1とすると

$\kappa_1=S_{LC1}/(S_{LC1}+S_{LC2})$…（９）

高画質と広視野角を両立させる好ましいκ_1の値は０．１から０．９で有り、より好ましくは０．２から０．８、更に好ましくは０．３から０．７で、理想的には０．４から０．６の間で有る。

【００４９】視野角特性は前述の（５）式を満たす関係、或いは（６）式を満たす関係に有るときに向上する。

【００５０】

$C_{LC2}/C_{NL2}=m_1(C_{LC1}/C_{NL1})$…（１０）

上記（１０）式にて係数m_1を定義すると（５）式（６）式は

$m_1<1$…（１１）

と記述される。このときに画質やＭＩＭ素子構造、画素電極構造を考慮して好ましいm_1の値の範囲は０．００１から０．９９９で有り、より好ましくは０．０１から０．９９、更に好ましくは０．１から０．９で有り、理想的には０．２から０．８の間で有る。

【００５１】本実施例の様に液晶駆動電極を複数の画素電極に分割する場合、画素電極間の分離距離ｄが高画質を得るのに重要な役割を演ずる。図１にｄで示す画素電

極間の分離距離が大きいと、コントラストの低下や光漏れ現象と言った問題が生ずるからで有る。分離距離ｄが十分に小さいときにはこれらの問題は生じない。と言うのは液晶表示装置が所望の情報を表示している状態で第一画素電極１０５と第二画素電極１０６には殆ど同じ電位が与えられており、為に液晶層１１２と液晶層１１３の液晶偏光状態は殆ど同じとなるからで有る。液晶の粘性係数はゼロでないので分離距離ｄが小さければ、この分離領域上の液晶層１１４は液晶層１１２と液晶層１１３に引きずられる形で応答し、偏光状態を変えるので有る。その結果コントラストの低下や光漏れが生じない訳で有る。もう少し正確に言うと、前述の様に第一画素電極１０５と第二画素電極１０６とには視野角特性を改善する為に異なった電位が与えられ、相応して液晶層１１２と液晶層１１３の偏光状態は異なった物となる。このとき分離距離ｄが小さければ分離領域上の液晶層１１４は液晶層１１２の偏光状態と液晶層１１３の偏光状態を結ぶ中間的な偏光状態と化する。所が、分離距離ｄが大きければ液晶層１１２の偏光状態や液晶層１１３の偏光状態とは関係なくして、分離領域上の液晶層１１４は常に液晶駆動電極電位がゼロに相応する偏光状態となってしまうので有る。出願人らはこうした観点に則り分離距離ｄの許される値を調査した所、分離距離ｄが１０μｍ以下で有ればコントラストの低下は殆ど問題にならず、７μｍ以下ではコントラストの低下は全く認められなかった。更に５μｍ以下ではノーマリー白表示モードで黒表示させたときの光漏れも全く認められなかった。即ち分離距離ｄが１０μｍ以下で有れば実用上殆ど問題はなく、５μｍ以下では分離領域上の液晶層１１４も正確に応答しているので有る。ここではスイッチング素子としてＭＩＭ素子を用いて説明したが、同じ事情はＴＦＴ素子等他のスイッチング素子を用いた場合にも無論適応可能で有る。ＴＦＴ素子をスイッチング素子として用い、一つの液晶駆動電極を複数の画素電極に分割する場合も画素電極間の分離距離ｄは１０μｍ以下が好ましく、より好ましくは７μｍ以下、更に好ましくは５μｍ以下で有る。

【００５２】他の一例としては上述と反対の場合も有効で有る。

【００５３】$C_{LC1}/C_{NL1} < C_{LC2}/C_{NL2}$…（１２）

すなわち

$S_{LC1}/S_{NL1} < S_{LC2}/S_{NL2}$…（１３）

とすれば上記とは逆に、液晶層１１２により視角を補償でき、上述と全く同様の効果が得られる。第一画素電極面積S_{LC1}と第二画素電極面積S_{LC2}を等しくした場合、

$S_{LC1} = S_{LC2}$…（７）

第一非線型抵抗素子で有る第一ＭＩＭ素子の面積S_{NL1}と第二非線型抵抗素子で有る第二ＭＩＭ素子の面積S_{NL2}の関係を

$S_{NL1} > S_{NL2}$…（１４）

とすれば（１３）式の関係は満たされ、広視野角と高画質は両立し、更に効果的に欠陥補修も可能となる。（１３）式を満たした状態で、第二画素電極面積S_{LC2}の第一画素電極と第二画素電極を合わせた面積$S_{LC1}+S_{LC2}$に対する比をκ_2とすると

$\kappa_2 = S_{LC2}/(S_{LC1}+S_{LC2})$…（１５）

高画質と広視野角を両立させる好ましいκ_2の値は０．１から０．９で有り、より好ましくは０．２から０．８、更に好ましくは０．３から０．７で、理想的には０．４から０．６の間で有る。

【００５４】視野角特性は前述の（１２）式を満たす関係、或いは（１３）式を満たす関係に有るときに向上する。

【００５５】

$C_{LC1}/C_{NL1} = m_2 (C_{LC2}/C_{NL2})$…（１６）

上記（１６）式にて係数m_2を定義すると（１２）式（１３）式は

$m_2 < 1$…（１７）

と記述される。このときに画質やＭＩＭ素子構造、画素電極構造を考慮して好ましいm_2の値の範囲は０．００１から０．９９９で有り、より好ましくは０．０１から０．９９、更に好ましくは０．１から０．９で有り、理想的には０．２から０．８の間で有る。

【００５６】本実施例で、第１導電体１０３としてＴａを例に説明したが、ＴａＭｏ、ＴａＷ、ＴａＳｉ、ＴａＳｉＷ等のＴａを成分とする合金、あるいはＡｌ、Ａｌを成分とする合金を用いる事も出来、陽極酸化法あるいは熱酸化法によりこれらの第一導電体を酸化して絶縁体１０４を形成してもよい。又、絶縁体１０４はスパッタ法、プラズマＣＶＤ法により成膜した窒化ケイ素を用いてもよい。

【００５７】〔実施例２〕図３は、本発明による別の実施例を示し、図３（ａ）は上視図、図３（ｂ）は図３（ａ）のＣＣ’における断面図である。

【００５８】ガラス等の第１基板４０１上に、Ｃｒ、Ａｌ、Ｍｏ等の金属よりなるＭＩＭ素子の第１導電体４０３を設ける。第１導電体４０３はデータ線を兼ね、データ線から１画素エリア（即ち一つの液晶駆動電極）当たり３本の突出部を設ける。次にＭＩＭ素子の絶縁体４０４をスパッタ法やプラズマＣＶＤ法等により窒化ケイ素或いは硬質炭素膜にて形成し、少なくとも上記３本の突出部を覆う様にパターニングする。絶縁体４０４は、必ずしもパターニングする必要はないが、第１基板４０１と、絶縁体４０４の屈折率の違いにより、液晶表示装置が色付いてしまう為、パターニングする方が好ましい。一方実施例１と同様に第１導電体４０３をＴａあるいはＴａを成分とする合金とし、陽極酸化法により絶縁体４０４を得てもよい。この場合、第１導電体４０３の表面のみが酸化される為、絶縁体４０４をパターニングする必要はない。一般にＴａあるいはＴａを成分とする合金

を陽極酸化する事で形成された絶縁体より、窒化シリコン膜や硬質炭素膜の方が非線型特性が優れている。こうした点や前述の製造方法の容易さ、液晶表示装置の画素数、あるいは要求される画質により最適な絶縁膜の材料を選択すればよい。次にＭＩＭ素子の第２導電体を兼ねた第一画素電極４０７、第二画素電極４０６、第三画素電極４０５を設ける。この結果、第１導電体４０３の３本の突出部に、第一ＭＩＭ素子４１０、第二ＭＩＭ素子４１１、第三ＭＩＭ素子４１２が形成される。ＭＩＭ素子の第２導電体と液晶駆動電極は実施例１で述べた様に別々の材料で構成してもよい。次に第１基板４０１と対向する位置に液晶層４０９を介して第２基板４０２を設ける。第２基板４０２には、ＩＴＯ等の透明導電体をストライプ状に加工した走査配線４０８を形成する。

【００５９】実施例１と本実施例の相違点は、一つの液晶駆動電極を液晶表示装置の広視野角が求められる方向にｎ個（ｎ≧２の整数）の画素電極に分割し、それぞれの画素電極にはそれぞれ独立な非線型抵抗素子を設ける事により、視野角特性を向上させる自由度を広げた点である。図３では液晶表示装置は液晶表示画面の垂直（縦又は上下）方向に広視野角が求められる使用状況を想定し、垂直方向に一つの液晶駆動電極を３分割（ｎ＝３）して有る。液晶表示装置の視野角特性は各液晶表示装置の応用状況によって異なる。例えばパーソナル・コンピュータ（ＰＣ）やエンジニアリング・ワーク・ステーション（ＥＷＳ）の表示画面に応用される対角２５ｃｍ～５０ｃｍ程度の大型液晶表示装置では表示画面の垂直（縦又は上下）方向に広視野角が求められる事が多い。又液晶表示装置をパチンコ台に組み込んだ場合も個人により目の高さが異なる為、垂直（縦又は上下）方向に広視野角が求められる。これらとは対照的に車載用テレビ等に適応される場合、一つの液晶表示装置を二人乃至は三人で水平（横又は左右）方向から眺める使用状況が多いと想定される為、寧ろ水平（横又は左右）方向に広視野角が求められる。後述する様に分割された画素電極で駆動される液晶容量と各ＭＩＭ素子容量の比を各画素電極毎に異ならせる事により視野角特性を改善できるので、広視野角が求められる方向に一つの液晶駆動電極を複数個の画素電極に分割するのが好ましい。図３の例では垂直（縦又は上下）方向に液晶駆動電極が分割されている為に正面からのコントラストが良好であると同時に、垂直（縦又は上下）方向の視野角が著しく大きくなる。このとき水平（横又は左右）方向の視野角は図２に示すがごとき従来の液晶表示装置と同様に狭いが、そもそもその方向に視野角は求められていないので有る。パチンコをしているとき人は自分の台の液晶表示装置のみに注視し、隣の台の液晶表示装置などに気を取られていないのが普通で有る。斯く故、液晶表示装置の広視野角が求められる方向に液晶駆動電極はｎ個（ｎ≧の整数）の画素電極に分割され、各画素電極にＭＩＭ型非線型抵抗素子を設け、各画素電極面積の非線型抵抗素子面積比を異ならせる事が好ましい。これにより正面からのコントラストを良好とした状態で尚、広視野角が求められる方向に所望通りの広視野角が得られるからである。広視野角が求められる方向はどの方向であっても構わぬが、普通は水平（横又は左右）方向か、或いは垂直（縦又は上下）方向で有る。従って垂直（縦又は上下）方向に広視野角が求められているときには図３の例が示す様に一つの液晶駆動電極を垂直（縦又は上下）方向にｎ個（ｎ≧の整数）に分割すれば良い。反対に水平（横又は左右）方向に広視野角が求められるときには図３ａを９０゜回転させて、一つの液晶駆動電極を水平（横又は左右）方向にｎ個（ｎ≧２の整数）に分割すれば良いわけで有る。

【００６０】次に各画素電極とそれらに接続されたＭＩＭ型非線型抵抗素子との関係を説明する。第一ＭＩＭ素子４１０、第二ＭＩＭ素子４１１、第三ＭＩＭ素子４１２の容量をそれぞれC_{NL1}、C_{NL2}、C_{NL3}とし、第一画素電極４０７で駆動される液晶層４１７、第二画素電極４０６で駆動される液晶層４１６、第三画素電極４０５で駆動される液晶層４１５の容量をそれぞれC_{LC1}、C_{LC2}、C_{LC3}とし、ＭＩＭ素子と液晶層の容量比が、

$C_{LC3}/C_{NL3} > C_{LC2}/C_{NL2} > C_{LC1}/C_{NL1}$ …（１８）

の関係を満たす様にすれば、矢印４１４の方向の視角特性を大幅に向上できる。第一ＭＩＭ素子４１０、第二ＭＩＭ素子４１１、第三ＭＩＭ素子４１２の絶縁体４０４は材料と厚さが総て等しく、液晶層４１５、４１６、４１７の材料と厚さも等しい為、実施例１と同様に第一ＭＩＭ素子４１０、第二ＭＩＭ素子４１１、第三ＭＩＭ素子４１２それぞれの面積をS_{NL1}、S_{NL2}、S_{NL3}とし、第一画素電極４０７、第二画素電極４０６、第三画素電極４０５のそれぞれの面積をS_{LC1}、S_{LC2}、S_{LC3}として上式を置き換えると、（１８）式は

$S_{LC3}/S_{NL3} > S_{LC2}/S_{NL2} > S_{LC1}/S_{NL1}$ …（１９）

で表される。従ってＭＩＭ素子と液晶層の容量比を変えるには、単にこれら面積比を変える事のみで容易に実現できる。

【００６１】一方、ＭＩＭ素子と液晶層の容量比が、

$C_{LC3}/C_{NL3} < C_{LC2}/C_{NL2} < C_{LC1}/C_{NL1}$ …（２０）

すなわち、

$S_{LC3}/S_{NL3} < S_{LC2}/S_{NL2} < S_{LC1}/S_{NL2}$ …（２１）

の関係を満たす様にすれば、矢印４１３方向の視角特性を向上できる。又、

$C_{LC3}/C_{NL3} = C_{LC1}/C_{NL1} < C_{LC2}/C_{NL2}$ …（２２）

すなわち、

$S_{LC3}/S_{NL3} = S_{LC1}/S_{NL1} < S_{LC2}/S_{LC2}$ …（２３）

の関係を満たす様にすれば、矢印４１３、４１４双方の視角特性を対称的に向上できる。

【００６２】矢印４１３、４１４双方の視角特性を向上する手段として、

$C_{LC3}/C_{NL3}<C_{LC1}/C_{NL1}<C_{LC2}/C_{NL2}$…（24）
すなわち、
$S_{LC3}/S_{NL3}<S_{LC1}/S_{NL1}<S_{LC2}/s_{NL2}$…（25）
の関係を満たす様にするかあるいは、
$C_{LC1}/C_{NL1}<C_{LC3}/C_{NL3}<C_{LC2}/C_{NL2}$…（26）
すなわち、
$S_{LC1}/S_{NL1}<S_{LC3}/S_{NL3}<S_{LC2}/S_{NL2}$…（27）
の関係を満たす事によっても実現できる。

【0063】実施例1中で説明した様に各画素電極を分離する分離距離ｄは10μm以下が好ましく、より好ましくは7μm以下、更に好ましくは5μm以下で有る。この事情は一つの液晶駆動電極を複数の画素電極に分割する場合に常に適合される。以下の実施例中でスイッチング素子としてＴＦＴ素子やＭＩＭ素子を用いて一つの液晶駆動電極を複数の画素電極に分割する例が幾つか現れてくる。それらの実施例では今後特にこの分離距離ｄに関して言及しないが、分離距離ｄの好ましい値は総て上述と同様で有る。

【0064】以上説明した様に、望まれる方向の視角特性を著しく向上させる自由度がプロセスや構造を複雑とする事なく簡単に実現でき、特にＰＣ用あるいはＥＷＳ用に用いられる対角25ｃｍ～50ｃｍ程度の大型液晶表示装置に適用した場合、目を固定していても画面の上下でコントラストや色調が違うという問題を解決できる。

【0065】本実施例では一例として液晶駆動電極を3分割した場合を例として説明したが、分割数を増やしてｎ分割（ｎ≧4の整数）とし、これらの画素電極の其れぞれには非線型抵抗素子を設け、ｉ番目（ｉは1からｎの間の任意の整数）の画素電極の面積S_{LCi}とし、ｉ番目の画素電極に設けられた非線型抵抗素子の面積をS_{NLi}としたとき、ｎ個のS_{LCi}/S_{NLi}の値が少なくとも2種類以上とすれば、更に視角特性向上の自由度が広がる事は明らかである。又、（23）式にてｎ＝3を用いて説明した様に、ｉ番目のS_{LCi}/S_{NLi}の値とｎ＋1－ｉ番目の$S_{LC(n+1-i)}/S_{NL(n+1-i)}$の値を等しくする事に依り広視野角が求められている方向の視角特性を対称的に向上できる。

【0066】〔実施例3〕図4は本発明に係わる別の実施例を示す。

【0067】ＭＩＭ素子の第1導電体を兼ねた第1データ線501と第2データ線502をそれぞれ1画素当たり1ヶ所の突出部を持つ様な形状に加工し、第一画素電極507と第二画素電極508の両サイドに配置する。後に形成される第二画素電極508は第一画素電極507の周囲に第一画素電極507を囲う様に形成され、これら第一画素電極507と第二画素電極508にて一つの液晶駆動電極を構成している。第1データ線501と第2データ線502は例えばＴａあるいはＴａＷ、ＴａＭｏ、ＴａＳｉ、ＴａＳｉＷ等のＴａを成分とする合金、又はＡｌあるいはＡｌを成分とする合金等の陽極酸化が可能な材料を用いる。次に第1データ線501と第2データ線502の表面を陽極酸化法により酸化し、ＭＩＭ素子の絶縁体となる第1絶縁体503及び第2絶縁体504を形成する。ＴａあるいはＴａを成分とする合金は、例えば0．01～1％程度の濃度のクエン酸やリン酸或いは酒石酸アンモニウム等の水溶液を用いて陽極酸化すれば容易に緻密な絶縁体が得られる。一方ＡｌあるいはＡｌを成分とする合金は、0．01～5％程度の濃度の酒石酸アンモニウム水溶液、あるいはエチレングリコール溶媒と酒石酸アンモニウムを溶質とした溶液を用い、両溶液ともアンモニア水によりＰＨを7．0～7．5に調整して陽極酸化すれば緻密な絶縁体が得られる。このとき、外部ドライバー回路と接続する端子エリア511には第1絶縁体503又は第2絶縁体504が形成されない様に、あらかじめ絶縁性有機物を形成して選択陽極酸化をする。或いは絶縁体が形成された場合はCF_4やSF_6等のフッ化系のガスを用いて、反応性イオンエッチング（ＲＩＥ）等のドライエッチング法により絶縁体を除去する。次にＭＩＭ素子の第2導電体を兼ねた第一画素電極507とこれを囲む様な形状に第二画素電極508を形成する。この結果、第1データ線501と第2データ線502のそれぞれの突出部に第一ＭＩＭ素子509と第二ＭＩＭ素子510が構成される。このとき、第1データ線501と第2データ線502へ同一のデータ信号が供給される様に端子エリア511にパット電極505を同時に形成する。ＭＩＭ素子の第2導電体と液晶駆動電極は実施例1と同様に別々の材料で形成してもよい事は言うまでもない。最後に、液晶層を介して第1データ線501と第2データ線502と直交するように走査配線506を設けて、液晶表示装置を構成する。

【0068】実施例1と本実施例の相違点（即ち本発明の特徴点）は第一画素電極507を駆動する第一ＭＩＭ素子509の電気的非線型特性と、第二画素電極508を駆動する第二ＭＩＭ素子510の電気的非線型特性を異なったものとする事により、視角特性を向上させる自由度を広げた点である。

【0069】本実施例に則ると、陽極酸化法により第1絶縁体503や第2絶縁体504を形成する際、2回に分けて陽極酸化を行い、異なった非線型特性を有する絶縁体を得る事が可能になる。図5に陽極酸化を行う際の略図を示す。ＭＩＭ素子をアレイ状に配置する第1基板601に第1データ線602と第2データ線603を形成する。複数の第1データ線602は例えば第1基板601の上部で全て接続され、第1陽極酸化パット605に接続する。複数の第2データ線603は第1データ線602とは逆に第1基板601の下部で全て接続され、第2陽極酸化パット606に接続する。端子エリア604は前にも述べた様に絶縁性有機物を形成し、陽極酸化

による絶縁体が形成されるのを防止する。クエン酸水溶液等の陽極酸化用化成液中へ第１基板６０１を破線６０７まで浸漬し、同一化成液中に設置した白金等の電極を陰極とし、第１陽極酸化パット６０５を陽極として、例えば３０Ｖの印加電圧で第１回目の陽極酸化を行う。次に第２陽極酸化パット６０６を陽極とし、例えば４０Ｖの印加電圧で第２回目の陽極酸化を行う。陽極酸化後破線６０７及び６０８で第１基板６０１を切断し、接続されていたデータ線を分離する。形成される絶縁体の膜厚は印加電圧に比例し、更に第１データ線６０２及び第２データ線６０３にＴａを用いた場合、１Ｖ当たり１７～１８Å成膜するため、第１絶縁体５０３の膜厚は５１０～５４０Åとなり、他方第２絶縁体５０４の膜厚は６８０～７２０Åとなる。この結果、実施例１とは違い、ＭＩＭ素子の面積だけではなく、絶縁体の膜厚も変える事が出来、ＭＩＭ素子と液晶層の容量比を変える自由度がより一層広げられる。

【００７０】一方、陽極酸化により得られたタンタル酸化物（TaO_x）中を流れるプールフレンケル電流Ｉは、

$$I = kV \quad \exp(\beta\sqrt{V})$$

で表され、βの値が非線型性を表す係数であり、βは絶縁体の膜厚をｄとすると膜厚の平方根に反比例する（$\beta \propto 1/\sqrt{d}$）。従って絶縁体の膜厚を変える事により非線型性も変えられ、容量比のみではなくＭＩＭ素子の非線型特性を変えて、第一画素電極５０７と第二画素電極５０８により駆動される液晶層に印加される電圧の実効値を広範囲に渡って制御可能となる。

【００７１】更に第１回目の陽極酸化をクエン酸水溶液で行い、第２回目の陽極酸化をリン酸水溶液で行う事により、第２絶縁体５０４中に不純物としてリンが取り込まれ、新たなトラップ準位を形成し、第１絶縁体５０３と第２絶縁体５０２の膜厚が同じ、すなわち第１回目の陽極酸化と第２回目の陽極酸化とで印加する電圧を同じにしても、第一ＭＩＭ素子５０９と第二ＭＩＭ素子５１０の非線型特性を変えられる。又、これに陽極酸化で印加する電圧を変える事で、より非線型特性を変える自由度が広がり、従来技術に比べ陽極酸化工程を１回増加するだけで、液晶表示装置の視角特性やコントラストを大幅に向上できる。ＭＩＭ型非線形抵抗素子の電気特性は陽極酸化方法を変える事で大幅に変化させ得る。本実施例記載の液晶表示装置は一回目の陽極酸化と二回目の陽極酸化で印加電圧や化成液、温度等の酸化条件を自由に変えて組み合わせる事が可能で、その様にして得られた異なるＭＩＭ素子がそれぞれの画素電極を独立に制御して一つの液晶駆動電極を駆動している。その結果コントラストや視野角と言った画質を自由に設定できるので有る。無論本実施例に於いても実施例１にて詳述した様に、画素電極面積のＭＩＭ素子面積比を変えて実施例１と同じ効果を得る事も可能で有る。しかしながら画素電極面積やＭＩＭ素子面積が液晶駆動電極のレイアウト上の制約やフォトリソグラフィーの精度等の制約で思う様に設定できぬ状況に於いても本実施例では二回の陽極酸化条件を異ならせる事で酸化膜の膜厚や組成などの構造を変え、広視野角と高画質を容易に両立させ得ぬので有る。加えて図４に示す本実施例の液晶表示装置に於いては第１データ線５０１或いは第２データ線５０２の何方か一方のデータ線が断線しても、両者が同時に断線しない限り線欠陥が生じないとの窮めて優れた特質が認められる。言う迄も無く図２に示すがごとき従来技術の液晶表示装置ではデータ線に一ヶ所でも断線が生ずると、その先には情報は伝達されぬが故正常な情報表示が行われぬ領域が線状に発生し、所謂線欠陥が視認されるに至る。図４に示す本実施例の液晶表示装置に於いても、データ線に断線が生ずるとその先に情報転送されぬ点は従来と同一で有る。しかるに本発明の液晶表示装置では一つの液晶駆動電極が第一画素電極とそれを取り囲む第二画素電極に分割されており、それぞれの画素電極に接続したＭＩＭ素子は独立なデータ線に接続されている為、片方のデータ線に断線等の異常が生じても、もう片方のデータ線とそれに接続したＭＩＭ素子を通じて情報伝達がなされるので有る。この場合断線から先の液晶駆動電極はそれを成す画素電極の片方が死んでいるから正常な情報表示は成されぬものの、生き残っているもう片方の画素電極が動作している為、致命的な線欠陥とはならないので有る。実施例１で説明した点欠陥補修にしろ、上述した線欠陥補修にしろ、それを効果的に行うには二つの画素電極形状が重要で有る。液晶駆動電極を単純にデータ線と平行又は直角に二分割するよりも、本願の様に一方の画素電極を他方の画素電極が取り囲む様に分割した方が明らかに効果的欠陥補修がなされる。これは取り分け、本実施例に示した線欠陥補修に於いて顕著で有る。

【００７２】〔実施例４〕図６は、本発明による別の実施例を示す。本実施例では液晶駆動電極が第一画素電極と第二画素電極に分割され、第一画素電極を駆動する第一非線型抵抗素子と、第一画素電極と前記第二画素電極が直列に接続される様に第二非線型抵抗素子及び第三非線型抵抗素子を設けて居る。

【００７３】走査配線を兼ねたＭＩＭ素子の第１導電体７０３を、１画素当たり１ヶ所の突出部を持つ様な形状に加工する。第１導電体７０３はＣｒ、Ｔａ等の金属で膜厚が１０００～５０００Å程度に形成するのが好ましい。更に好ましくは、走査配線を兼ねている為、走査信号の遅延を小さくする目的でより比抵抗の低いＡｌ、Ｃｕ等を用いれば、対角２５ｃｍ以上の大型液晶表示装置が実現できる。この第１導電体７０３と同時に第３導電体７０４を島状に形成する。次に少なくとも第１導電体７０３の突出部と第３導電体７０４を覆うようにＭＩＭ素子の絶縁体７０５を設ける。絶縁体７０５は実施例２

で示した絶縁体４０４と同様に必ずしもパターニングする必要はなく、窒化ケイ素膜や硬質炭素膜、酸化タンタル膜等を用いて、膜厚は３００～３０００Åとすれば良い。次にＭＩＭ素子の第２導電体を兼ねた第一画素電極７０６、この第一画素電極７０６の周辺を囲む形状に第二画素電極７０７を設ける。この結果、第１導電体７０３の突出部に第一ＭＩＭ素子７１０、第３導電体７０４と第一画素電極７０６あるいは第二画素電極７０７の交わる部分にそれぞれ第二ＭＩＭ素子７１１と第三ＭＩＭ素子７１２が直列接続となる様に形成される。第１基板７０１と液晶層７０９を介して対向する様にデータ線７０８を形成した第２基板７０２を配置する。この様に構成された液晶表示装置の等価回路を図７に示す。走査配線８０１とデータ線８０２の交点に、第一ＭＩＭ素子７１０に相当する第一ＭＩＭ素子８０３と第一画素電極７０６で駆動される液晶層８０６が直列に接続される。第一ＭＩＭ素子８０３と、液晶層８０６の中点より第二ＭＩＭ素子７１１に相当する第二ＭＩＭ素子８０４と、第三ＭＩＭ素子７１２に相当する第三ＭＩＭ素子８０５と、第二画素電極７０７で駆動される液晶層８０７が直列に接続され、データ線８０２へ結ばれる。走査配線８０１、データ線８０２にそれぞれ走査信号、データ信号を印加し、第一ＭＩＭ素子８０３をオン状態とし、第一画素電極７０６へ電荷を書き込んで液晶層８０６に所定の電界を掛ける。これと同時に第二画素電極へも第二ＭＩＭ素子８０４と第三ＭＩＭ素子８０５を通して電荷が書き込まれて液晶層８０７にも電界が印加される。この結果、液晶層８０６へ印加される実効電圧は液晶層８０７へ印加される実効電圧より大きくなり、液晶表示装置を正面から見た時のコントラストは液晶層８０６で確保され、更に斜めから見たときのコントラストは液晶層８０７で確保され、視野角が大幅に向上される。第二ＭＩＭ素子７１１及び第三ＭＩＭ素子７１２の面積を任意に変える事により液晶層８０７へ印加される実効電圧を幅広く変える事ができ、視野角を向上する自由度が広がっている。一方、一切プロセスを増やす事なく、第二ＭＩＭ素子７１１と第三ＭＩＭ素子７１２を構成できる事も大きな利点である。

【００７４】実施例１～実施例４において、便宜上図面に対して横方向を走査配線、縦方向をデータ線として説明したが、ＭＩＭ素子は２端子素子であり、走査配線とデータ線の交点に液晶層と直列に接続されるため、どちらを走査配線、データ線としても問題ない事は言うまでもない。

【００７５】〔実施例５〕本発明の別な一例を図８を用いて説明する。図８は第１基板１０１側に形成されたＭＩＭ素子とそのＭＩＭ素子に接続した画素電極の形状を示している。一つの液晶駆動電極は先に実施例１にて図１を用いて説明したのと同様に第一画素電極９０５と第二画素電極９０６に分割されている。第一画素電極９０５には導電体－絶縁体－導電体を順次積層した構造を有する第一非線型抵抗素子で有る第一ＭＩＭ素子９１１が接続されており、第二画素電極９０６にはやはり導電体－絶縁体－導電体を順次積層した構造を有する第二非線型抵抗素子で有る第二ＭＩＭ素子９１０が接続されている。この様に構成されている液晶駆動電極が複数個マトリックス状に第１基板側に形成され、第２基板１０２との間に挟持された液晶層１０９の光学状態を各液晶駆動電極毎に制御する事で情報表示が可能となる。この辺の事情は図１に示される前述の実施例１記載の発明の一例と全く同様で有る。図８に示す発明の特徴は第二画素電極９０６が第一画素電極９０５を囲い、且つ第二画素電極９０６の一部が第一画素電極９０５の内側に延在されている点に有る。こうする事に依り広視野角特性の改善と高画質の両立は一層容易になり、設計上の自由度も高まる。加えて第一画素電極と第二画素電極が互いに包含される関係になっている為、点欠陥の修復能力が実施例１の発明に比べても尚勝っている。その他の点に於いては総て実施例１と同様で有る。図８はＭＩＭ素子の第二導電体と画素電極が兼用された簡便な構造を有している。これに対して図９も本発明の一形態例で有り、ここではＭＩＭ素子の第二導電体と画素電極は別々に形成されている。即ち、第一画素電極１００５に接続した第一ＭＩＭ素子１０１１はＭＩＭ素子の絶縁体上にＣｒ、ＮｉＣｒＴａ、Ｔｉ等の金属或いは合金にて第二導電体１０１６が形成され、この第二導電体と画素電極が導通している。第二画素電極１００６と第二ＭＩＭ素子１０１０及びその第二導電体１０１５との関係も同様で有る。図９に示す様にＭＩＭ素子の第二導電体と画素電極を別々に形成すると、第二導電体の種類を変える事で非線型抵抗素子の電気特性を変えたり、素子面積を自由に設定出来、後述する様に高画質と広視野角とを簡単に実現出来る。こうした事情は他の実施例では特筆されていないが、他実施例でも同様に成り立っている。

【００７６】今第一ＭＩＭ素子９１１，１０１１の面積をS_{NL1}、第二ＭＩＭ素子９１０，１０１０の面積をS_{NL2}、ＭＩＭ素子の絶縁体膜厚をt_{NL}、絶縁体の比誘電率をε_{NL}、真空の誘電率をε_0とすると、第一ＭＩＭ素子の容量C_{NL1}と第二ＭＩＭ素子の容量C_{NL2}はそれぞれ、

$C_{NL1}=\varepsilon_0\cdot\varepsilon_{NL}\cdot S_{NL1}/t_{NL}$…（１）

$C_{NL2}=\varepsilon_0\cdot\varepsilon_{NL}\cdot S_{NL2}/t_{NL}$…（２）

となる。一方第一画素電極９０５，１００５の面積をS_{LC1}、第二画素電極９０６，１００６の面積をS_{LC2}、液晶層の厚さ、すなわち第１基板と第２基板のギャップをt_{LC}、液晶の比誘電率をε_{LC}とすると第一画素電極に対応する液晶容量C_{LC1}と第二画素電極に対応する液晶容量C_{LC2}はそれぞれ

$C_{LC1}=\varepsilon_0\cdot\varepsilon_{LC}\cdot S_{LC1}/t_{LC}$…（３）

$C_{LC2}=\varepsilon_0\cdot\varepsilon_{LC}\cdot S_{LC2}/t_{LC}$…（４）

となる。

【００７７】１例として視角特性を向上させる為に、

$C_{LC1}/C_{NL1}>C_{LC2}/C_{NL2}$…（５）

の関係を満たす様にすると、正面から見たコントラストは主として第一画素電極９０５，１００５により十分大きくなる。又第二画素電極９０６，１００６は斜めから見たときのコントラストを良くする事に寄与し、結果として広視野角を作り出す事となっている。第二画素電極の一部が第一画素電極の内側にまで延在され、互いに包含されている為、視野角特性は平均化され広い角度に渡って同一のコントラストが得られるので有る。これは特に中間調表示の画面を斜めから見たときに顕著となり、画面のネガポジ反転（白黒反転）を広い角度に渡って防止するのに大きな効果がある。実施例１と同様、式（５）に式（１）～（４）を代入して整理すると、

$S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$…（６）

となり単に面積比を変えれば上記の効果が得られる事が分かる。従来技術に比べ、構造やプロセスを複雑にする事なく、液晶駆動電極をパターニングする際のフォトマスクを変更する事のみで実現できる。図８，図９では第二画素電極面積の方が第一画素電極面積よりも大きくなっているが、この画素面積間の大小関係は液晶の種類や液晶層の厚さ、使用する印加電圧範囲等に基付き最適化される。唯、実施例１にも記述した様に本発明は単に高画質と広視野角を共に改善するにのみならず、一方の画素電極が不良であっても自動的に他方の画素によって欠陥補修されるとの利点も有している。こうした欠陥補修との観点からは第一画素電極９０５，１００５の面積と第二画素電極９０６，１００６の面積が等しい事が好ましい。もし何方か一方の画素電極面積が他方の画素電極面積よりも著しく大きければ、大きい画素電極に接続するＭＩＭ素子が不良となったとき、生き残っている正常なＭＩＭ素子に接続する画素電極が著しく小さくなり、その為に欠陥補修が効果的に行われないからで有る。即ち広視野角と高画質を両立させ、更に効果的に欠陥補修させるとの観点からは第一画素電極面積S_{LC1}と第二画素電極面積S_{LC2}は等しい事が好ましい。

【００７８】$S_{LC1}=S_{LC2}$…（７）

このとき第一非線型抵抗素子で有る第一ＭＩＭ素子の面積S_{NL1}と第二非線型抵抗素子で有る第二ＭＩＭ素子の面積S_{NL2}の関係を

$S_{NL1}<S_{NL2}$…（８）

とすれば、

$S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$…（６）

の関係を満たし、上述の効果を実現できる。本発明の液晶駆動電極は第一画素電極と第二画素電極の二つの画素電極に分割されているが、第一画素電極の外側を取り囲む第二画素電極の一部が第一画素電極の内側に延在されているが故、実質的には液晶駆動電極の外側から中心に向かって第二画素電極、第一画素電極、第二画素電極の三重構造になっている。この結果、実施例１に記した発明に比べても本発明は更に広視野角が実現されている。先に記した様に欠陥補修との観点からは第一画素電極面積と第二画素電極面積が等しい事が好ましいが、実質的に三重構造となっており、その内の二つが第二画素電極で有るとの事実からは第二画素電極面積S_{LC2}は第一画素電極面積S_{LC1}の２倍程度が好ましい。実施例１と同様に第一画素電極面積S_{LC1}の第一画素電極と第二画素電極を合わせた面積$S_{LC1}+S_{LC2}$に対する比をκ_1とすると

$\kappa_1=S_{LC1}/(S_{LC1}+S_{LC2})$…（９）

（６）式を満たした状態で高画質と広視野角を両立させ、更に効果的に欠陥補修し得る好ましいκ_1の値は０．０５から０．８で有り、より好ましくは０．１から０．７、更に好ましくは０．２から０．６で、理想的には０．３から０．５の間で有る。

【００７９】視野角特性は前述の（５）式を満たす関係、或いは（６）式を満たす関係に有るときに向上する。

【００８０】

$C_{LC2}/C_{NL2}=m_1(C_{LC1}/C_{NL1})$…（１０）

上記（１０）式にて係数m_1を定義すると（５）式（６）式は

$m_1<1$…（１１）

と記述される。このときに画質やＭＩＭ素子構造、画素電極構造を考慮して好ましいm_1の値の範囲は０．００１から０．９９９で有り、より好ましくは０．０１から０．９９、更に好ましくは０．１から０．９で有り、理想的には０．２から０．８の間で有る。

【００８１】本実施例の様に液晶駆動電極を複数の画素電極に分割する場合、画素電極間の分離距離ｄが高画質を得るのに重要な役割を演ずる。これに関しては実施例１に詳述した事情と全く同じで有る。分離距離ｄが１０μｍ以下で有ればコントラストの低下は殆ど問題にならず、７μｍ以下ではコントラストの低下は全く認められない。更に５μｍ以下ではノーマリー白表示モードで黒表示させたときの光漏れも全く認められない。

【００８２】他の一例としては上述と反対の場合も有効で有る。

【００８３】$C_{LC1}/C_{NL1}<C_{LC2}/C_{NL2}$…（１２）

すなわち

$S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$…（１３）

としても画素電極の実質的な三重構造には変わりがない為、上述と全く同様の効果が得られる。第一画素電極面積S_{LC1}と第二画素電極面積S_{LC2}を等しくした場合、

$S_{LC1}=S_{LC2}$…（７）

第一非線型抵抗素子で有る第一ＭＩＭ素子の面積S_{NL1}と第二非線型抵抗素子で有る第二ＭＩＭ素子の面積S_{NL2}の関係を

$S_{NL1}>S_{NL2}$…（１４）

とすれば（１３）式の関係は満たされ、広視野角と高画質は両立し、更に効果的に欠陥補修も可能となる。第二画素電極面積S_{LC2}の第一画素電極と第二画素電極を合わせた面積$S_{LC1}+S_{LC2}$に対する比をκ_2とすると

$\kappa_2=S_{LC2}/(S_{LC1}+S_{LC2})$ …（１５）

前述と同様、（１３）式を満たした状態で高画質と広視野角を両立させ、更に効果的に欠陥補修し得る好ましいκ_2の値は０．２から０．９５で有り、より好ましくは０．３から０．９、更に好ましくは０．４から０．８で、理想的には０．５から０．７の間で有る。

【００８４】視野角特性は前述の（１２）式を満たす関係、或いは（１３）式を満たす関係に有るときに向上する。

【００８５】

$C_{LC2}/C_{NL1}=m_2(C_{LC2}/C_{NL2})$ …（１６）

上記（１６）式にて係数m_2を定義すると（１２）式（１３）式は

$m_2<1$ …（１７）

と記述される。このときに画質やＭＩＭ素子構造、画素電極構造を考慮して好ましいm_2の値の範囲は０．００１から０．９９９で有り、より好ましくは０．０１から０．９９、更に好ましくは０．１から０．９で有り、理想的には０．２から０．８の間で有る。

【００８６】本発明の液晶駆動電極は二つの画素電極が外側から順に第二画素電極、第一画素電極、第二画素電極との順番に並ぶ三重構造に実質上なっている。液晶表示装置を正面から見たときのコントラストは主として第一画素電極９０５、１００５に依り確保されるが、視認される画質は液晶駆動電極全体の平均として得られる。視野角が比較点浅いときの画質補償は第一画素電極９０５，１００５によりなされ、視野角が深いときには第二画素電極９０６，１００６により補償されるので有る。

【００８７】尚本実施例で用いられるＭＩＭ型非線型抵抗素子は第１導電体としてＴａやＴａＭｏ、ＴａＷ、ＴａＳｉ、ＴａＳｉＷ等のＴａを成分とする合金、あるいはＡｌ、Ａｌを成分とする合金等が可能で有り、この場合陽極酸化法あるいは熱酸化法によりこれらの第一導電体を酸化して絶縁体が形成されてもよい。又、これらの合金や他の導電体を第１導電体として用いた場合、絶縁体はスパッタ法やプラズマＣＶＤ法により成膜した窒化ケイ素を用いても良いのは他実施例と同様で有る。

【００８８】〔実施例６〕本発明の別な一例を図１０を用いて説明する。図１０も実施例５の図８と同様、第１基板１０１側に形成されたＭＩＭ素子とそのＭＩＭ素子に接続した画素電極の形状を示している。一つの液晶駆動電極は第一画素電極１１０５と第二画素電極１１０６に分割されている。第一画素電極１１０５には導電体−絶縁体−導電体を順次積層した構造を有する第一非線型抵抗素子で有る第一ＭＩＭ素子１１１１が接続されており、第二画素電極１１０６にはやはり導電体−絶縁体−導電体を順次積層した構造を有する第二非線型抵抗素子で有る第二ＭＩＭ素子１１１０が接続されている。この様に構成されている液晶駆動電極が複数個マトリックス状に第１基板側に形成され、第２基板１０２との間に挟持された液晶層１０９の光学状態を各液晶駆動電極毎に制御する事で情報表示が可能となる。この辺の事情は前述の実施例１や実施例５記載の発明の一例と全く同様で有る。図１０に示す本発明の特徴は第二画素電極１１０６が第一画素電極１１０５を囲い、且つ第二画素電極１１０６の一部が第一画素電極１１０５の内側に延在されて居り、更に第一画素電極１１０５の一部は第二画素電極１１０６の内側に延在されている点に有る。こうする事により広視野角特性の改善と高画質の両立はより一層容易になり、設計上の自由度も高まる。加えて第一画素電極と第二画素電極が複雑に絡み合う関係になっている為、点欠陥の修復能力が実施例１や実施例５の発明に比べても尚勝っている。図１６に代表される従来技術の液晶駆動電極は単純に二分割されているに過ぎぬから、片方の画素電極が欠陥品で有るとき、そこは点欠陥として視認されてしまう。しかるに実施例５の図８や図９、或いは本実施例の図１０に示すがごとき液晶駆動電極は分割された二つの画素電極が複雑に絡み合っている為、仮令一方の画素電極が不良で有っても正常な情報に対応する光と異常な情報に対応する光が混合し、致命的欠陥には到らぬ訳で有る。換言すれば、スイッチング素子にＭＩＭ素子を用いるとか、或いはＴＦＴ素子を用いるかとのスイッチング素子材に関係なく、一つの液晶駆動電極を二つ以上の複数の画素電極に分割して点欠陥に対する自動修復能力を装備させようとするならば、分割された複数の画素電極が互いに複雑に絡み合っていた方が光混合が確実に生じてより効果的に欠陥補修が成されるので有る。それ故実施例１の図１に示す発明は図１６に代表される従来技術よりも欠陥補修能力が優れ、図１よりは実施例５の図８の方が更に勝っているので有る。同じ理由で本実施例の図１０は図８よりも更に欠陥補修能力は高い訳で有る。この結果は液晶駆動電極が大きい液晶表示装置ほど顕著と化す。

【００８９】次に本発明が単に欠陥自動修復能力に優れているにのみならず、高画質と高視野角特性もやはり優れている点を説明する。今第一ＭＩＭ素子１１１１の面積をS_{NL1}、第二ＭＩＭ素子１１１０の面積をS_{NL2}、ＭＩＭ素子の絶縁体膜厚をt_{NL}、絶縁体の比誘電率をε_{NL}、真空の誘電率をε_0とすると、第一ＭＩＭ素子の容量C_{NL1}と第二ＭＩＭ素子のC_{NL2}はそれぞれ、

$C_{NL1}=\varepsilon_0\cdot\varepsilon_{NL}\cdot S_{NL1}/t_{NL}$ …（１）

$C_{NL2}=\varepsilon_0\cdot\varepsilon_{NL}\cdot S_{NL2}/t_{NL}$ …（２）

となる。一方第一画素電極１１０５の面積をS_{LC1}、第二画素電極１１０６の面積をS_{LC2}、液晶層の厚さ、すなわち第１基板と第２基板のギャップをt_{LC}、液晶の比誘電率をε_{LC}とすると第一画素電極に対応する液晶容量

C_{LC1}と第二画素電極に対応する液晶容量C_{LC2}はそれぞれ

$C_{LC1}=\varepsilon_0\cdot\varepsilon_{LC}\cdot S_{LC1}/t_{LC}$…（３）

$C_{LC2}=\varepsilon_0\cdot\varepsilon_{LC}\cdot S_{LC2}/t_{LC}$…（４）

となる。

【００９０】１例として視角特性を向上させる為に、

$C_{LC1}/C_{NL1}>C_{LC2}/C_{NL2}$…（５）

の関係を満たす様にすると、正面から見たコントラストは主として第一画素電極１１０５により十分大きくなる。又第二画素電極１１０６は斜めから見たときのコントラストを良くする事に寄与し、結果として広視野角を作り出す事となっている。第二画素電極の一部が第一画素電極の内側にまで延在され、更に第一画素電極の一部が第二画素電極の内側に延在され互いに複雑に絡み合っている為、視野角特性は平均化され広い角度に渡って同一のコントラストが得られる結果と化す。これは特に中間調表示の画面を斜めから見たときに顕著となり、画面のネガポジ反転（白黒反転）を実施例５の図８に比べても尚広い角度に渡って防止するのに大きな効果がある。実施例１や実施例５と同様、式（５）に式（１）～（４）を代入して整理すると、

$S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$…（６）

となり単に面積比を変えれば上記の効果が得られる事が分かる。言う迄も無く、本発明に於いても従来技術に比べ構造やプロセスを複雑にする事なく、液晶駆動電極をパターニングする際のフォトマスクを変更する事のみで実現できる。図１０に示す発明の一例では第一画素電極の面積と第二画素電極面積との関係に特別な配慮は払っていないが、この画素面積間の大小関係は液晶の種類や液晶層の厚さ、使用する印加電圧範囲等に基付き最適化される。但し他の実施例にも記述した様に本発明は高画質と広視野角を共に改善すると同時に欠陥補修を自動的に行う事も可能となっている。こうした欠陥補修との観点からはやはり第一画素電極１１０５の面積と第二画素電極１１０６の面積が等しい事が好ましい。もし何方か一方の画素電極面積が他方の画素電極面積よりも著しく大きければ、大きい画素電極に接続するＭＩＭ素子が不良となったとき、生き残っている正常なＭＩＭ素子に接続する画素電極が著しく小さくなり、その為に欠陥補修が効果的に行われないからで有る。即ち広視野角と高画質を両立させ、更に効果的に欠陥補修させるとの観点からは第一画素電極面積S_{LC1}と第二画素電極面積S_{LC2}は等しい事が好ましい。

【００９１】$S_{LC1}=S_{LC2}$…（７）

このとき第一非線型抵抗素子で有る第一ＭＩＭ素子の面積S_{NL1}と第二非線型抵抗素子で有る第二ＭＩＭ素子の面積S_{NL2}の関係を

$S_{NL1}<S_{NL2}$…（８）

とすれば、

$S_{LC1}/S_{NL1}>S_{LC2}/S_{NL2}$…（６）

の関係を満たし、上述の効果を実現できる。本発明の液晶駆動電極は第一画素電極と第二画素電極の二つの画素電極に分割されており、第一画素電極の外側を取り囲む第二画素電極の一部が第一画素電極の内側に延在されており、更に第一画素電極の一部は第二画素電極の内側に延在されているが故、実質的には液晶駆動電極の外側から中心に向かって第二画素電極、第一画素電極、第二画素電極、第一画素電極の四重構造になっている。四重構造の内の二重分は第一画素電極が占め、残りの二重分が第二画素電極によって占有されている。即ち一つの液晶駆動電極を二つの画素電極が略半分づつ構成している事になる。先に記した様に欠陥補修との観点からも第一画素電極面積と第二画素電極面積が等しい事が好ましいから、実施例１と同様に二つの画素面積は等しい事が望まれる。先と同様に第一画素電極面積S_{LC1}の第一画素電極と第二画素電極を合わせた面積$S_{LC1}+S_{LC2}$に対する比をκ_1とすると

$\kappa_1=S_{LC1}/(S_{LC1}+S_{LC2})$…（９）

高画質と広視野角を両立させ、更に効果的に欠陥補修し得る好ましいκ_1の値は０．１から０．９で有り、より好ましくは０．２から０．８、更に好ましくは０．３から０．７で、理想的には０．４から０．６の間で有る。

【００９２】視野角特性は前述の（５）式を満たす関係、或いは（６）式を満たす関係に有るときに向上する。

【００９３】

$C_{LC2}/C_{NL2}=m_1(C_{LC1}/C_{NL1})$…（１０）

上記（１０）式にて係数m_1を定義すると（５）式（６）式は

$m_1<1$…（１１）

と記述される。このときに画質やＭＩＭ素子構造、画素電極構造を考慮して好ましいm_1の値の範囲は０．００１から０．９９９で有り、より好ましくは０．０１から０．９９、更に好ましくは０．１から０．９で有り、理想的には０．２から０．８の間で有る。

【００９４】本実施例の様に液晶駆動電極を複数の画素電極に分割する場合、画素電極間の分離距離ｄが高画質を得るのに重要な役割を演ずる点も他実施例と同様で有る。これに関しては実施例１に詳述した事情と全く同じで有る。分離距離ｄが１０μｍ以下で有ればコントラストの低下は殆ど問題にならず、７μｍ以下ではコントラストの低下は全く認められない。更に５μｍ以下ではノーマリー白表示モードで黒表示させたときの光漏れも全く認められない。

【００９５】他の１例としては上述と反対の場合も有効で有る。

【００９６】$C_{LC1}/C_{NL1}<C_{LC2}/C_{NL2}$…（１２）

すなわち

$S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}$…（１３）

としても画素電極の実質的な四重構造には変わりがない

為、上述と全く同様の効果が得られる。第一画素電極面積S_{LC1}と第二画素電極面積S_{LC2}を等しくした場合、

$S_{LC1}=S_{LC2}$…（７）

第一非線型抵抗素子で有る第一ＭＩＭ素子の面積S_{NL1}と第二非線型抵抗素子で有る第二ＭＩＭ素子の面積S_{NL2}の関係を

$S_{NL1}>S_{NL2}$…（１４）

とすれば（１３）式の関係は満たされ、広視野角と高画質は両立し、更に効果的に欠陥補修も可能となる。第二画素電極面積S_{LC2}の第一画素電極と第二画素電極を合わせた面積$S_{LC1}+S_{LC2}$に対する比をκ_2とすると

$\kappa_2=S_{LC2}/(S_{LC1}+S_{LC2})$…（１５）

前述と同様、高画質と広視野角を両立させ、更に効果的に欠陥補修し得る好ましいκ_2の値は０．１から０．９で有り、より好ましくは０．２から０．８、更に好ましくは０．３から０．７で、理想的には０．４から０．６の間で有る。

【００９７】視野角特性は前述の（１２）式を満たす関係、或いは（１３）式を満たす関係に有るときに向上する。

【００９８】

$C_{LC1}/C_{NL1}=m_2(C_{LC2}/C_{NL2})$…（１６）

上記（１６）式にて係数m_2を定義すると（１２）式（１３）式は

$m_2<1$…（１７）

と記述される。このときに画質やＭＩＭ素子構造、画素電極構造を考慮して好ましいm_2の値の範囲は０．００１から０．９９９で有り、より好ましくは０．０１から０．９９、更に好ましくは０．１から０．９で有り、理想的には０．２から０．８の間で有る。

【００９９】本発明の液晶駆動電極は二つの画素電極が外側から順に第二画素電極、第一画素電極、第二画素電極、第一画素電極との順番に並ぶ四重構造に実質上なっている。液晶表示装置を正面から見たときのコントラストは主として第一画素電極１１０５により確保されるが、視認される画質は液晶駆動電極全体の平均として得られる。視野角が比較点浅いときの画質補償は第一画素電極１１０５によりなされ、視野角が深くなると第二画素電極１１０６により補償されるので有る。視野角が更に深くなると画質補償は再度第一画素電極１１０５により成され、最深時には第二画素電極１１０６が二度目の画質補償を行う事になる。本実施例では図１０に示す画素電極形状を例として論じてきたが、高画質と高視野角の両立及び欠陥自動修復能力の見地に立つと第一画素電極とそれを取り囲む第二画素電極はより複雑に絡み合っているのが好ましい。

【０１００】尚本実施例で用いられるＭＩＭ型非線型抵抗素子は第１導電体としてＴａやＴａＭｏ、ＴａＷ、ＴａＳｉ、ＴａＳｉＷ等のＴａを成分とする合金、あるいはＡｌ、Ａｌを成分とする合金等が可能で有り、この場合陽極酸化法あるいは熱酸化法によりこれらの第一導電体を酸化して絶縁体が形成されてもよい。又、これらの合金や他の導電体を第１導電体として用いた場合、絶縁体はスパッタ法やプラズマＣＶＤ法により成膜した窒化ケイ素を用いても良いのは他実施例と同様で有る。

【０１０１】〔実施例７〕本発明に係わる別の一例を図１１を用いて説明する。図１１は第一基板側に形成された非線型抵抗素子で有るＭＩＭ素子と複数（図１１の例では４個）の同心状画素電極より成る一つの液晶駆動電極を示している。非線型抵抗素子で有るＭＩＭ素子は導電体－絶縁体－導電体を順次積層した構造を有しており、各画素電極には一つのＭＩＭ素子が接続されている。この様なＭＩＭ素子と液晶駆動電極が複数個マトリックス状に第１基板側に形成され、第２基板との間に挟持された液晶層の光学状態を各液晶駆動電極毎に制御する事で情報表示が可能になる。図１１に示す発明の特徴は一つの液晶駆動電極が複数個の同心状画素電極に分割され、各同心状画素電極にはそれぞれ非線型抵抗素子が設けられている点に有る。実際、図１１の例では一つの液晶駆動電極が内側から順に第一画素電極１２１１、第二画素電極１２１２、第三画素電極１２１３、第四画素電極１２１４と４分割され、各画素電極には第一ＭＩＭ素子１２０１、第二ＭＩＭ素子１２０２、第三ＭＩＭ素子１２０３、第四ＭＩＭ素子１２０４が接続されている。図１１の例では液晶駆動電極の分割個数は４個で有るが、この数は複数個で有れば幾つで有っても構わない。分割数が２個の場合は図１を用いて実施例１にて説明した発明に対応する。後に説明する様に分割数が多い程高画質が広い視野角に渡って得られるが、余り沢山の同心状画素電極に分割し過ぎると各画素電極の幅が各画素電極間の分離距離ｄに近くなってしまう。こうした事態に陥ると仮令画素電極間の分離距離が小さくとも光漏れやコントラストの低下は免れないからで有る。従って液晶駆動電極の最大分割数は各画素電極の最小幅が分離距離の３倍程度以上となる数が好ましい。例えば液晶駆動電極の大きさが縦１５０μｍ、横１００μｍでＭＩＭ素子の幅（図１１ではＷで記述）が１０μｍ、画素電極間分離距離ｄが２．５μｍとした場合、各画素電極の最小幅は分離距離の３倍程度だから２．５μｍ×３＝７．５μｍ程度で有る。分離距離２．５μｍと最小画素電極幅７．５μｍを合わせた最小ピッチは１０μｍとなる。従ってこの例では最大分割数は図１１の様に４個となる。この様な条件を満たしている限り、画素分割により画素電極間分離領域に起因するコントラストの低下や光漏れは生じない。

【０１０２】液晶駆動電極が本発明の様に複数個の同心状画素電極に分割されていると、まず極めて効果的に欠陥補修が成される。例えば図１１で第一ＭＩＭ素子１２０１が不良で第一画素電極１２１１が正しい情報表示を行わなくとも、他の正常なＭＩＭ素子と画素電極でこの

欠陥を補償できるからで有る。液晶駆動電極をn個の同心状画素電極に分割すれば、各画素電極の全体に対する寄与はおよそ1／nで有る。従って分割数が多い程、一つの画素電極が不良となったときの正常な情報表示からのずれは小さくなるので有る。加えて、もし画素電極の分離距離が1μm程度以下で、各画素電極の最大幅が5μm程度以下で有れば、仮令一つのMIM素子が不良で有っても、その不良素子を含む液晶駆動電極は略完全に等しい正しい情報を表示出来る。図11の例で各画素電極の最大幅w_{max}が5μm、分離距離dが1μmで有るとしよう。今第三MIM素子1203が不良で第三画素電極1213には全く電位が掛からない状況を考える。この場合従来の液晶表示装置では一つの液晶駆動電極に一つのMIM素子が接続されているから、当然画素欠陥となる。又本発明に有ってもw_{max}が非常に大きければ第三画素電極1213と第二基板に挟まれた液晶は全く応答せず、この液晶駆動電極に対応する液晶の内、約1／nは正常な光学状態にならない。（最も異常な成分の割合が1／n程度だから欠陥補修で有るのだが。）所が各画素電極の最大幅が5μm程度以下で有れば、この例の場合、正常に動作する第二画素電極1212と第四画素電極1214間の距離が7μm程度となり、これら両画素電極には殆ど同じ情報が供与される事となる。実施例1で画素電極間分離距離dの演ずる役割を説明したが、それと全く同じ原理で不良の第三画素電極1213上の液晶も正常に応答し、その結果この液晶駆動電極は略完全に等しい正しい情報表示が可能になる。こうした作用が効果的に働く為には各画素電極の最大幅が小さい事が必要となる。一方で前述の如く画素電極間分離距離は画素電極の最小幅の1／3以下がコントラストや光漏れ等の課題より好ましい。一例を述べると画素電極間分離距離が1μmの場合、最小画素電極幅は3μm以上で最大画素電極幅は5μm以下で有る。画素電極間分離距離が0．5μmの場合、最小画素電極幅は1．5μm以上で最大画素電極幅は6μm程度以下で有る。分離距離が0．5μmと小さいときには最小画素電極幅を2．5μm以上、最大画素電極幅を4μm以下とすれば、より好ましい。同様に画素電極間分離距離が0．1μmで有れば最小画素電極幅は0．3μm以上で最大画素電極幅は6．8μm以下で有る。最小画素電極幅は分離距離の3倍以上で有れば大きければ大きい程コントラストや光漏れの点より好ましく、最大画素電極幅は最大画素電極幅に分離距離の2倍を加えた値が7μm程度より小さければ小さい程欠陥補修能力は向上する。従って分離距離は小さければ小さい程良い。但し可視光波長の上限が＊0．8μm程度で有るので最小画素電極幅はやはり0．8μm程度以上は必要となる。即ち画素電極間分離距離が0．1μmならば、最小画素電極幅は0．8μm以上がより好ましく、更に好ましくは1．5μm以上、理想的には2．5μm以上で有る。一方このときの最大画素電極幅は4．8μm以下がより好ましく、望ましくは3．8μm以下、理想的には2．8μm以下で有る。画素電極間分離距離が0．1μmで最小画素電極幅と最大画素電極幅が共に2．8μmで有る場合、最小ピッチは3．0μmとなり、先の液晶駆動電極幅が100μmの例では一つの液晶駆動電極を13個から14個の同心状画素電極に分割できる。前述した欠陥自動補修能力の点からも、後述する高画質と高視野角の同時改善との点からも同心状画素電極への分割数は多い方が好ましいから、この例に従うと極めて優良な液晶表示装置が実現される。

【0103】次に液晶駆動電極をn個（n≧2の整数）の同心状画素電極に分割し、i番目（iは1からnの間の任意の整数）の同心状画素電極の面積をS_{LCi}とし、その同心状画素電極に設けられた非線型抵抗素子の面積をS_{NLi}としたとき、n個のS_{LCi}／S_{NLi}が総て同じで無ければ高画質と高視野角が得られる事を説明する。実施例1でも詳述した様にn個のS_{LCi}／S_{NLi}の値はそれぞれn個のC_{LCi}／C_{NLi}に等しくなる。ここでC_{LCi}とはi番目の同心状画素電極に制御される液晶の容量であり、C_{NLi}はi番目の同心状画素電極に設けられたMIM型非線型抵抗素子の容量で有る。従ってn個のS_{LCi}／S_{NLi}の値が一つでも異なっていれば、n個のC_{LCi}／C_{NLi}の値もそれに対応するものが異なり、視野角特性が向上するので有る。尚、各画素電極は同じ同心状で有るから視角特性はどの方向から見ても向上する。原理的にはn個のS_{LCi}／S_{NLi}の値が少なくとも二種類以上有れば従来例に比べて視角特性は向上する。しかしながら、より広い視角特性を得るにはn個のS_{LCi}／S_{NLi}の値にはなるべく沢山の種類が有った方が好ましく、可能ならばn個の値が総て皆異なっている状況が望まれる。一般にこれらの値は単に面積を変えるだけで済むので容易に達成される。図11の例では第一MIM素子1201も第二MIM素子1202も第三MIM素子1203も第四MIM素子1204も、総て皆同じ素子面積を有している。即ち、

$S_{NL1}=S_{NL2}=S_{NL3}=S_{LN4}$…（28）

の関係に有る。一方各同心状画素電極の面積は

$S_{LC1}<S_{LC2}<S_{LC3}<S_{LC4}$…（29）

として有る。従って面積比は

$S_{LC1}/S_{NL1}<S_{LC2}/S_{NL2}<S_{LC3}/S_{NL3}<S_{LC4}/S_{NL4}$…（30）

と四個のS_{LCi}／S_{NLi}の値は総て異なり、この比は内側の同心状画素電極に行く程小さくなっている。この場合第四画素電極1214に制御される液晶に印加される実効電圧が最大となり、正面から見たときのコントラストは第四画素電極1214で定まる。視野角が正面からずれたときには順次内側の画素電極がコントラスト補償を行う事となる。即ち視野角が比較的浅いときは主として第三画素電極に1213がコントラスト補償を行い、そ

れよりも視野角が大きくなると主にコントラスト補償を行う画素電極は第二画素電極１２１２へと移り、視野角が更に大きくなると第一画素電極１２１１がコントラスト補償を主として受け持つ事となる。この例が示す様に分割された各画素電極面積とその画素電極に接続したＭＩＭ型非線型抵抗素子面積との比S_{LCi}/S_{NLi}は総て異なっていた方がより広い視野角が得られる。更にこの比の変化具合はこの例が示す様に外側から内側に向かって単調に変化するのが好ましい。即ち最も内側に位置する画素電極を第一画素電極とし、それに接続したＭＩＭ型非線型抵抗素子を第一ＭＩＭ素子と名付け、以下順次外側に進むにつれ第二、第三とし、最も外側に位置する画素電極とＭＩＭ型非線型抵抗素子をそれぞれ第ｎ画素電極及び第ｎＭＩＭ素子としたとき、

$S_{LCi}/S_{NLi} < S_{LCi+1}/S_{NLi+1}$ …（３１）

か、

$S_{LCi}/S_{NLi} > S_{LCi+1}/S_{NLi+1}$ …（３２）

となっているのが好ましい。但しここでｉは１からｎ－１の間の任意の整数で有る。（３１）式のｉに１，２，３を代入すると先の例で示した（３０）式の関係が得られ、S_{LCi}/S_{NLi}の値は内側に行く程小さくなる。反対に（３２）の場合はS_{LCi}/S_{NLi}は外側に行く程小さくなる。この場合正面からのコントラスト補償は最も内側に位置する第一画素電極によって行われ、視角が深くなったときのコントラスト補償は順次外側の画素電極によって受け持たれ、最も視角が深くなったときは最も外側に位置する第ｎ画素電極によってコントラストは補償される。この様な関係は各画素電極の幅を調整したり、或いはＭＩＭ素子部の第二導電体面積を調整する等により得られる。。図１１の例が示す様に、

$S_{NLi} = S_{NLi+1}$ …（３３）

（ｉは１からｎ－１の間の任意の整数）と総ての非線型抵抗素子面積が等しければ、

$S_{LCi} < S_{LCi+1}$ …（３４）

により（３１）式が満たされ、

$S_{LCi} > S_{LCi+1}$ …（３５）

で（３２）式が満たされる。（３４）、（３５）いずれの式でも高画質と広視野角が得られるのは先に説明した通りで有る。この様に素子面積を総て等しくし、画素電極面積を変えて広視野角を得る場合、自動的に最も大きい画素電極が最大のS_{LCi}/S_{NLi}の値を有する事となる。即ち（３４）式を満たす関係に有るときは最も外側に位置する第ｎ画素電極面積S_{LCn}が最大で、その結果ｎ個のS_{LCi}/S_{NLi}の値の内、S_{LCn}/S_{NLn}が最大となる。同様に（３５）式を満たす関係に有るときは最も内側に位置する第一画素電極面積S_{LC1}が最大で、ｎ個のS_{LCi}/S_{NLi}の内S_{LC1}/S_{NL1}が最大となる。正面からのコントラストはｎ個のS_{LCi}/S_{NLi}の内で最大の物によって得られるから、最も大きい同心状画素電極が正面からの画素を保障する事となる。本発明により高画質と広視野角が容易に両立するが、その内でも特に正面からの画質を重視する場合、この様に（３３）～（３５）を満たす事で最も使用状況が多い状態で確実に高画質が得られるので有る。

【０１０４】ここまではＭＩＭ素子面積が等しく、画素電極面積を異ならせて高画質と広視野角を得てきたが、その逆も無論可能で有る。即ち各画素電極面積を等しくし、ＭＩＭ素子面積を異ならせるので有る。先と同様、一つの液晶駆動電極をｎ個の同心状画素電極に分割し、内側から外側に向かって一番からｎ番目の番号を定義したとき、

$S_{LCi} = S_{LCi+1}$ …（３６）

により、総ての画素電極面積は等しくなる。但しここでもｉは１からｎ－１の間の任意の整数で有る。更に

$S_{NLi} > S_{NLi+1}$ …（３７）

とすれば（３１）の関係式が得られ、

$S_{NLi} < S_{NLi+1}$ …（３８）

とすれば（３２）の関係式が得られる。（３７）式は最も内側に位置する第一ＭＩＭ素子の面積が最大で、以下外側のＭＩＭ素子程小さくなっていき、最も外側に位置する第ｎＭＩＭ素子の面積が最小となっている。（３８）式はこの反対で内側のＭＩＭ素子が外側のＭＩＭ素子よりも小さい事を表している。このＭＩＭ素子面積を異ならせて画素電極面積を総て等しくした液晶表示装置は視野角特性が著しく改善される。最小ＭＩＭ素子が接続した画素電極が正面からの画質を保障し、最大ＭＩＭ素子が接続した画素電極が視野角が最も深いときのコントラストを保障するからで有る。これらの画素電極面積が総て皆等しい事は取りも直さず正面からの画質も深視野角からの画質も同等で有る事を意味する。従ってここで説明した関係（３６）～（３８）を満たす液晶表示装置は特に広視野角が必要となる装置に最適で有る。同時にこの液晶表示装置は効果的な自動欠陥修復能力を備えている。各画素電極面積が皆等しいから、どの一つの画素電極が不良で有っても正常な情報からのずれは常に１／ｎと化すが故で有る。

【０１０５】ＭＩＭ素子面積が等しく画素電極面積が異なる場合にしろ、画素電極面積が等しくＭＩＭ素子面積が異なる場合にしろ、或いは（３１）式の様に面積比（S_{LCi}/S_{NLi}を今後面積比と呼ぶ。）が内側程小さい場合にしろ、逆に（３２）式の様に外側程小さい場合にしろ、面積比は内側から外側に向かって単調に変化するのが好ましい。液晶表示装置のコントラスト特性は視野角が深くなって行くに従い単調に連続的に変化する。それ故そのコントラスト補償を主として行う同心状画素電極も単調に連続的な変化を行えば自然になめらかな感じで画質保障が行われるので有る。その意味では一つの液晶駆動電極のｎ個の同心状画素電極への分割個数は多ければ多い程良い。分割個数が少なければ主としてコントラスト補償を行う同心状画素電極はステップ状の飛び飛

びの変化を示すが、分割個数が多ければ連続的な変化に近づいて行くからで有る。分割個数ｎが非常に多ければ連続的に変化するコントラストの視野角依存性に合致する様に各面積比を略連続的に定める事が可能になり、コントラストの視野角依存性を抹消する事も可能となる。高画質と広視野角をより確実に得る為には分割個数ｎを出来る限り大きくし、面積比を内側から外側に向けて単調に変化させる事が肝要なので有る。

【０１０６】尚本実施例で用いられるＭＩＭ型非線型抵抗素子は第１導電体としてＴａやＴａＭｏ、ＴａＷ、ＴａＳｉ、ＴａＳｉＷ等のＴａを成分とする合金、あるいはＡｌ、Ａｌを成分とする合金等が可能で有り、この場合陽極酸化法あるいは熱酸化法によりこれらの第一導電体を酸化して絶縁体が形成されてもよい。又、これらの合金や他の導電体を第１導電体として用いた場合、絶縁体はスパッタ法やプラズマＣＶＤ法により成膜した窒化ケイ素を用いても良いのは他実施例と同様で有る。

【０１０７】〔実施例８〕本発明の別な一例を図１２と図１３を用いて説明する。図１２と図１３は第１基板側に形成されたスイッチング素子とそのスイッチング素子に接続した画素電極の形状を示している。本発明の液晶表示装置は液晶を駆動する為に第一基板側にマトリックス状に形成された複数個の液晶駆動電極と、この液晶駆動電極に接続されたスイッチング素子とで構成されて居る。一つの液晶駆動電極は櫛歯状第一画素電極と櫛歯状第二画素電極に分割されて居り、櫛歯状第一画素電極には第一スイッチング素子が接続され、櫛歯状第二画素電極には第二スイッチング素子が接続されて居る。更に櫛歯状第一画素電極と櫛歯状第二画素電極は互いに噛合って居るので有る。本実施例ではスイッチング素子としてＭＩＭ型非線型抵抗素子を用いて居るが、本発明の第一の特徴はこの様な画素電極形状に有るのでスイッチング素子としてはＴＦＴ素子等他のスイッチング素子も可能で有る。図１２では櫛歯状第一画素電極と櫛歯状第二画素電極は水平方向に互いに噛合って居り、図１３では櫛歯状第一画素電極と櫛歯状第二画素電極は垂直方向に互いに噛合って居る。実施例２で図３を用いて説明した様に、液晶表示画面の垂直（上下又は縦）方向に高視野角が求められるときには図１２に示す様に二つの櫛歯状画素電極を水平方向に噛み合わせる。反対に液晶表示画面の水平（左右又は横）方向に高視野角が求められるときには図１３に示す様に二つの櫛歯状画素電極を垂直方向に噛み合わせる。一つの液晶駆動電極は櫛歯状第一画素電極１３１１、１３３１、１４１１、１４３１と櫛歯状第二画素電極１３１２、１３３２、１４１２、１４３２に分割されている。櫛歯状第一画素電極１３１１には導電体－絶縁体－導電体を順次積層した構造を有する第一スイッチング素子で有る第一非線型抵抗素子（第一ＭＩＭ素子）１３０１が接続されており、櫛歯状第二画素電極１３１２にはやはり導電体－絶縁体－導電体を順次積層した構造を有する第二スイッチング素子で有る第二非線型抵抗素子（第二ＭＩＭ素子）１３０２が接続されている。以下同様に櫛歯状第一画素電極１３３１には第一ＭＩＭ素子１３２１が接続され、櫛歯状第二画素電極１３３２には第二ＭＩＭ素子１３２２が接続されている。又、櫛歯状第一画素電極１４１１には第一ＭＩＭ素子１４０１が接続され、櫛歯状第二画素電極１４１２には第二ＭＩＭ素子１４０２が接続されて居る。更に櫛歯状第一画素電極１４３１には第一ＭＩＭ素子１４２１が接続され、櫛歯状第二画素電極１４３２には第二ＭＩＭ素子１４２２が接続されているので有る。この様に構成されている液晶駆動電極が複数個マトリックス状に第１基板側に形成され、第２基板との間に挟持された液晶層の光学状態を各液晶駆動電極毎に制御する事で情報表示が可能となる。この辺の事情は図１に示される前述の実施例１記載の発明の一例と全く同様で有る。図１２及び図１３に示す発明の特徴は櫛歯状第一画素電極と櫛歯状第二画素電極が互いに噛み合って一つの液晶駆動電極を構成し、各画素電極には独立なスイッチング素子が設けられている点に有る。これにより点欠陥の自動修復が効果的に行われる。実施例６にて図１０を用いて説明した様に一つの液晶駆動電極を二つの画素電極に分割して欠陥自動修復能力を装備させる場合、分割された二つの画素電極は互いに複雑に絡み合っていた方が良い。これにより二つの画素電極を通過した光が混合するからで有る。例えば今、ノーマリー白表示モードで黒表示しようとしたとき、一方のスイッチング素子が不良でそのスイッチング素子には黒表示に対応する電位が掛からない状況を考える。図１６に示す従来の液晶表示装置では光混合が全く生じないので不良素子に接続した画素電極上の液晶はまっすぐに光を透過し、事実上程度の小さい輝点欠陥となっていた。ところが本発明では光混合が生じるので不良画素に対応する白と正常画素に対応する黒が混じり合って、中間の灰色となる。無論正しく表示されるべき情報は今の例では黒だから、灰色表示は厳密には不良情報を表示している事を意味する。しかし液晶表示装置を実用する上では小さい輝点欠陥と灰色表示とでは雲泥の差が有る。輝点欠陥は大変目立つ為致命的だが、灰色の欠陥はかなり注意して見ないと通常は見つからないからで有る。即ち本発明は窮めて効果的に欠陥自動補修を行っている。櫛歯状画素電極の櫛歯の幅ｗと画素電極間分離距離ｄの関係、及び互いに噛み合っている櫛歯の数（図１２、図１３の例ではそれぞれ２個の櫛歯が噛み合っている。）の関係は実施例７にて図１１を用いて説明した同心状画素電極の最小幅、最大幅w_{max}と画素電極間分離距離ｄ及び画素電極の分割個数の関係に等しい。即ち光漏れやコントラストの低下を招かぬ為には櫛歯の最小幅は画素電極間分離距離ｄの３倍以上が必要で有る。又先と同様、画素電極間分離距離ｄが１０μｍ以下で有ればコントラストの低下は殆ど問題にならず、７μｍ以下

ではコントラストの低下は全く認められない。更に５μm以下ではノーマリー白表示モードで黒表示させたときの光漏れも全く認めらなくなる。もし画素電極間分離距離が１μm程度以下で、各櫛歯の最大幅が５μm程度以下で有れば、仮令一方のＭＩＭ素子が不良で有っても、他方のＭＩＭ素子と其に接続した櫛歯状画素電極に依りその不良素子を含む液晶駆動電極は略完全に等しい正しい情報を表示出来る。この辺の事情は実施例７と同様で有る。即ち一例として、画素電極間分離距離を１μmとすると、櫛歯の最小幅は３μm以上で最大幅は５μm以下で有る。或いは画素電極間分離距離を０．５μmとした場合、櫛歯の最小幅は１．５μm以上で最大幅は矢張５μm程度以下で有る。分離距離が０．５μmと小さいときには櫛歯の最小幅を１．５μm以上、最大電極幅を４μm以下とすれば、より好ましい。同様に画素電極間分離距離が０．１μmで有れば最小幅は０．３μm以上で最大幅は３．８μm以下で有る。櫛歯の最小幅は分離距離の３倍以上で有れば大きければ大きい程コントラストや光漏れの点より好ましく、最大幅は最大幅に分離距離の２倍を加えた値が７μm程度より小さければ小さい程欠陥補修能力は向上する。従って分離距離は小さければ小さい程良い。先にも述べた様に可視光波長の上限が０．８μm程度で有るので最小画素電極幅はやはり０．８μm程度以上は必要となる。結局画素電極間分離距離が０．１μmならば、櫛歯の最小幅は０．８μm以上がより好ましく、更に好ましくは１．５μm以上、理想的には２．５μm以上で有る。一方このときの最大幅は４．８μm以下がより好ましく、望ましくは３．８μm以下、理想的には２．８μm以下で有る。

【０１０８】こうする事により広視野角特性の改善と高画質の両立はより容易になり、設計上の自由度も高まる。加えて第一画素電極と第二画素電極が互いに交互に噛み合って居る構造と成って居る為、点欠陥の修復能力が実施例１の発明に比べても尚勝っている。

【０１０９】さてこれ迄の議論と同様に第一ＭＩＭ素子１３０１，１３２１，１４０１，１４２１の面積をS_{NL1}、第二ＭＩＭ素子１３０２，１３２２，１４０２，１４２２の面積をS_{NL2}、ＭＩＭ素子の絶縁体膜厚をt_{NL}、絶縁体の比誘電率をε_{NL}、真空の誘電率をε_0とすると、第一ＭＩＭ素子の容量C_{NL1}と第二ＭＩＭ素子の容量C_{NL2}はそれぞれ、

$C_{NL1} = \varepsilon_0 \cdot \varepsilon_{NL} \cdot S_{NL1} / t_{NL}$ …（１）

$C_{NL2} = \varepsilon_0 \cdot \varepsilon_{NL} \cdot S_{NL2} / t_{NL}$ …（２）

となる。一方櫛歯状第一画素電極１３１１，１３３１，１４１１，１４３１の面積をS_{LC1}、櫛歯状第二画素電極１３１２，１３３２，１４１２，１４３２の面積をS_{LC2}、液晶層の厚さ、すなわち第１基板と第２基板のギャップをt_{LC}、液晶の比誘電率をε_{LC}とすると櫛歯状第一画素電極に対応する液晶容量C_{LC1}と櫛歯状第二画素電極に対応する液晶容量C_{LC2}はそれぞれ

$C_{LC1} = \varepsilon_0 \cdot \varepsilon_{LC} \cdot S_{LC1} / t_{LC}$ …（３）

$C_{LC2} = \varepsilon_0 \cdot \varepsilon_{LC} \cdot S_{LC2} / t_{LC}$ …（４）

となる。

【０１１０】一例として視角特性を向上させる為に、

$C_{LC1} / C_{NL1} > C_{LC2} / C_{NL2}$ …（５）

の関係を満たす様にすると、正面から見たコントラストは主として櫛歯状第一画素電極１３１１，１３３１，１４１１，１４３１により十分大きくなる。又櫛歯状第二画素電極１３１２，１３３２，１４１２，１４３２は斜めから見たときのコントラストを良くする事に寄与し、結果として広視野角を作り出す事となっている。二つの櫛歯状画素電極が互いに噛み合って居るので、視野角特性は平均化され広い角度に渡って同一のコントラストが得られるので有る。これは特に中間調表示の画面を斜めから見たときに顕著となり、画面のネガポジ反転（白黒反転）を広い角度に渡って防止するのに大きな効果がある。実施例１と同様、式（５）に式（１）～（４）を代入して整理すると、

$S_{LC1} / S_{NL1} > S_{LC2} / S_{NL2}$ …（６）

となり単に面積比を変えれば上記の効果が得られる事が分かる。従来技術に比べ、構造やプロセスを複雑にする事なく、液晶駆動電極をパターニングする際のフォトマスクを変更する事のみで実現できる。実施例１にも記述した様に本発明は単に高画質と広視野角を共に改善するにのみならず、一方の画素電極が不良であっても自動的に他方の画素によって欠陥補修されるとの利点も有している。こうした欠陥補修との観点からは櫛歯状第一画素電極１３１１，１３３１，１４１１，１４３１の面積と櫛歯状第二画素電極１３１２，１３３２，１４１２，１４３２の面積が等しい事が好ましい。もし何方か一方の画素電極面積が他方の画素電極面積よりも著しく大きければ、大きい画素電極に接続するＭＩＭ素子が不良となったとき、生き残っている正常なＭＩＭ素子に接続する画素電極が著しく小さくなり、その為に欠陥補修が効果的に行われないからで有る。即ち広視野角と高画質を両立させ、更に効果的に欠陥補修させるとの観点からは櫛歯状第一画素電極面積S_{LC1}と櫛歯状第二画素電極面積S_{LC2}は等しい事が好ましい。

【０１１１】$S_{LC1} = S_{LC2}$ …（７）

このとき第一非線型抵抗素子で有る第一ＭＩＭ素子の面積S_{NL1}と第二非線型抵抗素子で有る第二ＭＩＭ素子の面積S_{NL2}の関係を

$S_{NL1} < S_{NL2}$ …（８）

とすれば、

$S_{LC1} / S_{NL1} > S_{LC2} / S_{NL2}$ …（６）

の関係を満たし、上述の効果を実現できる。ＭＩＭ素子面積と櫛歯状画素電極面積の両者を最適化する場合、櫛歯状第一画素電極面積S_{LC1}の櫛歯状第一画素電極と櫛歯状第二画素電極を合わせた面積$S_{LC1} + S_{LC2}$に対する比をκ_1とすると

$\kappa_1 = S_{LC1} / (S_{LC1} + S_{LC2})$ …（９）

高画質と広視野角を両立させ、更に効果的に欠陥補修し得る好ましいκ_1の値は０．１から０．９で有り、より好ましくは０．２から０．８、更に好ましくは０．３から０．７で、理想的には０．４から０．６の間で有る。

【０１１２】視野角特性は前述の（５）式を満たす関係、或いは（６）式を満たす関係に有るときに向上する。

【０１１３】

$C_{LC2} / C_{NL2} = m_1 (C_{LC1} / C_{NL1})$ …（１０）

上記（１０）式にて係数m_1を定義すると（５）式（６）式は

$m_1 < 1$ …（１１）

と記述される。このときに画質やＭＩＭ素子構造、画素電極構造を考慮して好ましいm_1の値の範囲は０．００１から０．９９９で有り、より好ましくは０．０１から０．９９、更に好ましくは０．１から０．９で有り、理想的には０．２から０．８の間で有る。

【０１１４】他の一例としては上述と反対の場合も有効で有る。

【０１１５】$C_{LC1} / C_{NL1} < C_{LC2} / C_{NL2}$ …（１２）

すなわち

$S_{LC1} / S_{NL1} < S_{LC2} / S_{NL2}$ …（１３）

としても上述と全く同様の効果が得られる。櫛歯状第一画素電極面積S_{LC1}と櫛歯状第二画素電極面積S_{LC2}を等しくした場合、

$S_{LC1} = S_{LC2}$ …（７）

第一非線型抵抗素子で有る第一ＭＩＭ素子の面積S_{NL1}と第二非線型抵抗素子で有る第二ＭＩＭ素子の面積S_{NL2}の関係を

$S_{NL1} > S_{NL2}$ …（１４）

とすれば（１３）式の関係は満たされ、広視野角と高画質は両立し、更に効果的に欠陥補修も可能となる。櫛歯状第二画素電極面積S_{LC2}の櫛歯状第一画素電極と櫛歯状第二画素電極を合わせた面積$S_{LC1} + S_{LC2}$に対する比をκ_2とすると

$\kappa_2 = S_{LC2} / (S_{LC1} + S_{LC2})$ …（１５）

前述と同様、高画質と広視野角を両立させ、更に効果的に欠陥補修し得る好ましいκ_2の値は０．１から０．９で有り、より好ましくは０．２から０．８、更に好ましくは０．３から０．７で、理想的には０．４から０．６の間で有る。

【０１１６】視野角特性は前述の（１２）式を満たす関係、或いは（１３）式を満たす関係に有るときに向上する。

【０１１７】

$C_{LC1} / C_{NL1} = m_2 (C_{LC2} / C_{NL2})$ …（１６）

上記（１６）式にて係数m_2を定義すると（１２）式（１３）式は

$m_2 < 1$ …（１７）

と記述される。このときに画質やＭＩＭ素子構造、画素電極構造を考慮して好ましいm_2の値の範囲は０．００１から０．９９９で有り、より好ましくは０．０１から０．９９、更に好ましくは０．１から０．９で有り、理想的には０．２から０．８の間で有る。

【０１１８】尚本実施例で用いられるＭＩＭ型非線型抵抗素子は第１導電体としてＴａやＴａＭｏ、ＴａＷ、ＴａＳｉ、ＴａＳｉＷ等のＴａを成分とする合金、あるいはＡｌ、Ａｌを成分とする合金等が可能で有り、この場合陽極酸化法あるいは熱酸化法によりこれらの第一導電体を酸化して絶縁体が形成されてもよい。又、これらの合金や他の導電体を第１導電体として用いた場合、絶縁体はスパッタ法やプラズマＣＶＤ法により成膜した窒化ケイ素を用いても良いのは他実施例と同様で有る。

【０１１９】〔実施例９〕本発明の別な一例を図１４と図１５を用いて説明する。図１４と図１５は第１基板側に形成されたスイッチング素子とそのスイッチング素子に接続した画素電極の形状を示している。本発明の液晶表示装置は液晶を駆動する為に第一基板側にマトリックス状に形成された複数個の液晶駆動電極と、この液晶駆動電極に接続されたスイッチング素子とで構成されて居る。一つの液晶駆動電極は櫛歯状第一画素電極と櫛歯状第二画素電極に分割されて居り、櫛歯状第一画素電極には第一スイッチング素子が接続され、櫛歯状第二画素電極には第二スイッチング素子が接続されて居る。更に櫛歯状第一画素電極と櫛歯状第二画素電極は互いに噛合って居るので有る。本実施例ではスイッチング素子としてＴＦＴ素子を用いて居る点で実施例８と異なって居るが、互いに噛み合って居る櫛場状画素電極がもたらす効果、即ち欠陥補修能力に関しては全く同じで有る。従って櫛歯状画素電極の最小幅や最大幅wmax、及び画素電極間分離距離ｄの関係も実施例８で詳述したその内容と同一で有る。更に第一画素電極の面積と第二画素電極の面積が等しければ、より効果的に欠陥補修をする事に成る。

【０１２０】さて図１４では一つの液晶駆動電極は櫛歯状第一画素電極１５１１と櫛歯状第二画素電極１５１２に分割されて居り、櫛歯状第一画素電極１５１１には第一薄膜トランジスタ１５０１が接続され、櫛歯状第二画素電極１５１２には第二薄膜トランジスタ１５０２が接続されて居る。ここでは第一薄膜トランジスタも第二薄膜トランジスタも同一導電タイプとして居る。それ故第一薄膜トランジスタのゲート電極も第二薄膜トランジスタのゲート電極も共通の走査線１５２に接続され、更に共通の信号電位を第一及び第二画素電極に印加する為に第一薄膜トランジスタのソース電極と第二薄膜トランジスタのソース電極も共通の信号線１５３に接続されて居る。この様な構成とした場合、一つの液晶駆動電極が一つの画素電極から成り一つの薄膜トランジスタに依りスイッチングされる従来の液晶表示装置と全く同じ製造工

程にて本願発明の液晶表示装置が製造され、更に従来と全く同じ駆動方法にて本願発明の液晶表示装置を駆動し得る。結局従来技術に対して何等新たな負荷を加える事無く、上述した効果的な自動欠陥補修能力を備えさせる事が可能と成るので有る。

【０１２１】一方図１５では一つの液晶駆動電極が第一画素電極１６１１と第二画素電極１６１２に分割されて居り、第一画素電極１６１１には第一薄膜トランジスタ１６０１が接続され、第二画素電極１６１２には第二薄膜トランジスタ１６０２が接続されて居る。ここで第一薄膜トランジスタのゲート電極は第一走査線１６２１に接続されて居り、第二薄膜トランジスタのゲート電極は第二走査線１６２２に接続されて居る。又第一薄膜トランジスタのソース電極と第二薄膜トランジスタのソース電極は共通の信号線１６３に接続されて居る。更に第一薄膜トランジスタ１６０１と第二薄膜トランジスタ１６０２は互いに逆導電タイプと成って居る。例えば第一薄膜トランジスタ１６０１がN型導電タイプで有れば、第二薄膜トランジスタ１６０２はP型導電タイプで有る。これに相応して第一走査線と第二走査線とには常に同じタイミングで逆極性の走査信号が印加される。先の例に則ると走査線１６２１と１６２２が同時に選択されると、N型ＴＦＴが接続された第一走査線にはＨｉｇｈの信号電位が印加されN型ＴＦＴ１６０１はｏｎ状態と成り、他方Ｐ型ＴＦＴが接続された第二走査線にはＬｏｗの信号電位が印加されてＰ型ＴＦＴ１６０２もｏｎ状態と成る。反対にこれらの信号線が非選択の状態ではN型ＴＦＴが接続された第一走査線にはＬｏｗの信号電位が印加され、Ｐ型ＴＦＴが接続された第二走査線にはＨｉｇｈの信号電位が印加され、両ＴＦＴはｏｆｆ状態と成る。第一薄膜トランジスタも第二薄膜トランジスタも同一の信号線１６３に接続されて居り、更に常に同一のタイミングでｏｎ－ｏｆｆを行う為、第一画素電極と第二画素電極とには常に同一の信号電位が印加される。本願ではこの様に液晶駆動電極に接続されたスィッチング素子がＣＭＯＳ構成を取っている。その為信号電位の極性の正負に拘り無く常に正しい電位が液晶駆動電極に全体として印加され得る。例えば正極性の信号電位が信号線１６３に入ったとき、スィッチング素子がN型ＴＦＴだけから成る従来の液晶表示装置ではゲート電位（V_{gs}）が低下して仕舞い、それが故トランジスタのｏｎ抵抗が増大して限られた選択時間内に正しい電位を液晶駆動電極に印加出来ないで居た。これに対して本願発明ではＣＭＯＳ構成と成って居る為、どちらか一方のＴＦＴは必ず完全ｏｎ状態と成る。先の例に従えばN型ＴＦＴのゲート電位は低下してN型ＴＦＴのｏｎ抵抗は大きく成って居るが、その一方でＰ型ＴＦＴのゲート電位が増大しＰ型ＴＦＴのｏｎ抵抗は最小と化して居る（Ｐ型ＴＦＴが完全ｏｎ状態）。負極性の信号電位が信号線１６３に印加されたときはこの例の反対でN型ＴＦＴが完全ｏｎ状態と成る。換言すれば従来の液晶表示装置が信号電位に応じてＴＦＴのｏｎ抵抗が変動して正しい情報を表示出来ないで居たのに対して、本願発明では信号電位に拘り無くｏｎ抵抗は平均化されてその変動は小さく成り、故に常に正しい情報が表示され得るので有る。加えて本願発明では櫛歯状画素電極により光混合（第一画素電極により変調された光と第二画素電極により変調された光の混合）が行われて居る為平均化は更に進み、あらゆる表示信号に対して常に正しい表示が可能に成る訳で有る。画素スィッチング素子をＣＭＯＳ　ＴＦＴとする事は製造上の新たな工程を求められる様に感ぜられるが、多結晶半導体（例えばｐｏｌｙ－Ｓｉ）ＴＦＴにて走査線回路や信号線回路を基板上に内蔵する場合にはＣＭＯＳ回路が通常採用されるので、こうした液晶表示装置では本願発明は新たな工程を全く追加するに至らない。斯様な視点からは本願発明は特に多結晶薄膜半導体装置にて周辺回路（走査線回路や信号線回路などの一部乃至は全部）を内蔵した液晶表示装置に適して居ると言える。

【０１２２】さて第一薄膜トランジスタ１６０１をN型導電タイプとし、第二薄膜トランジスタ１６０２をＰ型導電タイプとしたとき、第一薄膜トランジスタが接続した第一画素電極１６１１の面積は第二薄膜トランジスタが接続した第二画素電極１６１２の面積よりも大きい事が好ましい。これはN型ＴＦＴとＰ型ＴＦＴのトランジスタサイズ（チャンネルの長さや幅）を同じにしたときN型ＴＦＴのｏｎ抵抗の方がＰ型ＴＦＴのｏｎ抵抗よりも小さい事に由来する。こうする事で先に述べた平均化は更に進み、より正確な情報表示が実現されるので有る。無論第一画素電極１６１１と第二画素電極１６１２が櫛歯状で互いに噛合って居れば、光混合に依る平均化も同時に達成されて更に好ましい。

【０１２３】これ迄の実施例で詳述して来た様に一つの液晶駆動電極を複数の画素電極に分割するときには其々の画素電極面積が等しい事が望まれる。これに依り欠陥の自己補修能力が一段と向上するからで有る。従ってN型ＴＦＴとＰ型ＴＦＴのｏｎ抵抗の相違を画素電極面積の相違にて相殺させる上述の方法よりも、二つの画素電極面積を同一として素子特性を同じにした方が優れていると言える。これは液晶駆動電極が第一画素電極１６１１と第二画素電極１６１２に分割されて居り、第一画素電極にはN型導電タイプの第一薄膜トランジスタ１６０１が接続され、第二画素電極にはＰ型導電タイプの第二薄膜トランジスタ１６０２が接続され、第一薄膜トランジスタのゲート電極は第一走査線１６２１に接続されて居り、第二薄膜トランジスタのゲート電極は第二走査線１６２２に接続されて居り、第一薄膜トランジスタのチャンネル長をL_1、チャンネル幅をW_1とし、第二薄膜トランジスタのチャンネル長をL_2、チャンネル幅をW_2としたとき、

$$W_1/L_1 < W_2/L_2$$

との関係式を満たす事で達成される。これはN型ＴＦＴとＰ型ＴＦＴのチャンネルコンダクタンス（移動度や閾値電圧により定まる電気伝導度）の相違をチャンネルディメンジョン（ＬやＷ）で調整してｏｎ抵抗を揃える物で有る。普通はN型ＴＦＴのチャンネルコンダクタンスのほうがＰ型ＴＦＴのチャンネルコンダクタンスよりも大きい為、上述の関係式の様にN型ＴＦＴのＷ／ＬをＰ型ＴＦＴのＷ／Ｌよりも小さくすれば両ＴＦＴのｏｎ電流を揃える事が出来、それ故二つの画素電極面積を同一としてもなお、二つの画素電極電位を同等とする事が実現される。無論これはレイアウトの都合などから両ＴＦＴのWが等しいなどと云った場合、第一薄膜トランジスタのチャンネル長が第二薄膜トランジスタのチャンネル長より長いとの関係でも達成される。同様に第一薄膜トランジスタのチャンネル幅が第二薄膜トランジスタのチャンネル幅よりも狭いとしても構わない。第一画素電極及び第二画素電極は図１５に示す様に櫛歯状で互いに噛合って居り、両者の面積が等しい事が理想で有るが、必ずしもこれらの条件が満たされずともある程度の効果は期待される。

【０１２４】

【発明の効果】本発明により液晶駆動電極を第一画素電極と、この第一画素電極の周辺を囲む様に構成した第二画素電極にて分割し、それぞれに独立して設けた第一ＭＩＭ素子、第二ＭＩＭ素子で駆動する事により、あらゆる方向からの視角特性が向上し、欠陥補修が可能となる。又、第一画素電極、第二画素電極、第一ＭＩＭ素子、第二ＭＩＭ素子のそれぞれの面積をS_{LC1}、S_{LC2}、S_{NL1}、S_{NL2}とし、S_{LC1}/S_{NL1}とS_{LC2}/S_{NL2}の比を変える事により、第一画素電極により駆動される液晶層の実効電圧と、第二画素電極により駆動される液晶層の実効電圧を別々に制御でき、視角特性が向上できる。更に、

$S_{LC1}/S_{NL1} > S_{LC2}/S_{NL2}$

の関係を満たす事により、液晶表示装置を正面から見たときのコントランストを第一画素電極で確保し、斜めから見たときのコントラストを第二画素電極で確保し、画面を斜めから見たときのネガポジ反転を防止でき、表示品位の高い液晶表示装置を実現できる。（１０）式の係数m_1や（１６）式の係数m_2の値を限定する事に依り視野角特性は著しく向上する。又、（７）式と（８）式、あるいは（７）式と（１４）式を満たす事に依り高視野角と高画質を両立し、更に効果的に欠陥補修出来る。

（９）式のκ_1や（１５）式のκ_2を数値限定する事に依り高視野角と高画質が両立する。

【０１２５】$S_{LC1}/S_{NL1} < S_{LC2}/S_{NL2}$

の関係を満たす事により、液晶表示装置を正面から見たときのコントラストを第二画素電極で確保し、斜めから見たときのコントラストを第一画素電極で確保し、視野角の広い液晶表示装置を実現できる。これらは単に面積比を変える事により上記効果が得られ、構造やプロセスを複雑化する事なく、フォトマスクを変更するという簡単な手段で実現できる。

【０１２６】更に、一つの液晶駆動電極をｎ個の画素電極に分割し、それぞれの画素電極を独立したＭＩＭ素子で駆動する事により、視角特性を向上させる自由度が広げられる。例えばｎ＝３と分割したとき、それぞれ画素電極の面積をS_{LC1}、S_{LC2}、S_{LC3}とし、それぞれの画素電極を駆動するＭＩＭ素子の面積をそれぞれS_{NL1}、S_{NL2}、S_{NL3}とし、

$S_{LC3}/S_{NL3} > S_{LC2}/S_{NL2} > S_{LC1}/S_{NL1}$

あるいは、

$S_{LC3}/S_{NL3} < S_{LC2}/S_{NL2} < S_{LC1}/S_{NL1}$

あるいは、

$S_{LC3}/S_{NL3} = S_{LC1}/S_{NL1} < S_{LC2}/S_{LC2}$

あるいは、

$S_{LC3}/S_{NL3} < S_{LC1}/S_{NL1} < S_{LC2}/S_{NL2}$

あるいは、

$S_{LC1}/S_{NL1} < S_{LC3}/S_{NL3} < S_{LC2}/S_{NL2}$

のいずれかの関係を満たす事により、視角特性を飛躍的に向上できる。更に液晶駆動電極を３分割に限定せず、ｎ分割とする事により、より大きな効果が期待でき、特にＰＣ用あるいはＥＷＳ用等に用いられる対角２５ｃｍ～５０ｃｍ程度の大型液晶表示装置に適用した場合、目を固定していても画面の上下でコントラスト、色調が違うという問題を解決できる。

【０１２７】また、液晶駆動電極を２分割し、それぞれを独立して駆動する２個のＭＩＭ素子の絶縁体の厚さを変える事により、非線型特性を制御し、その結果、視角特性の向上が可能となる。或いはＭＩＭ素子の絶縁体の厚さのみならず面積も同時に変える事により、視角特性向上の自由度が大幅に広げられる。

【０１２８】更にＭＩＭ素子の絶縁体を陽極酸化法により形成する際、２つのＭＩＭ素子の絶縁体を別々の種類の溶液により陽極酸化し、絶縁体の非線型特性を制御する事ができ、先と同様の効果が期待できる。

【０１２９】液晶駆動電極を２分割し、分割した液晶駆動電極をＭＩＭ素子で結合する事により、液晶層に印加される実効電圧を別々に制御し、対角特性を向上できる。

【０１３０】又液晶駆動電極を複数個の画素電極に分割し、其々の画素電極により変調される光を効果的に混合する事により欠陥補修能力や階調表示特性を著しく向上せしめた。

【図面の簡単な説明】

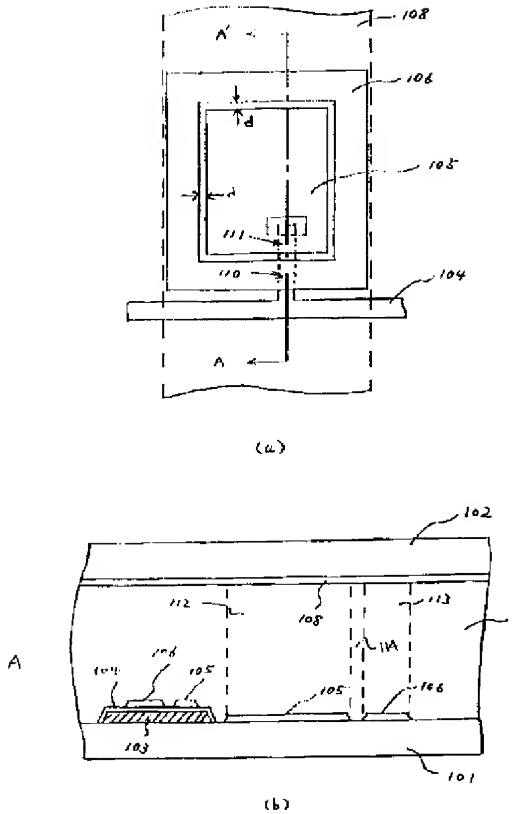
【図１】　図１は実施例１に係る本発明の液晶表示装置を示す図である。

【図２】　図２は従来の液晶表示装置を示す図である。

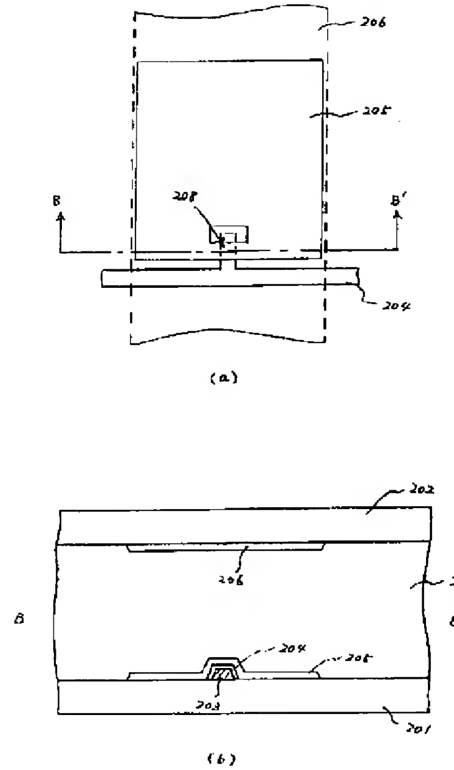
【図３】　図３は実施例２に係る本発明の液晶表示装置を示す図である。

【図４】　図４は実施例３に係る本発明の液晶表示装置を示す図である。
【図５】　図５は実施例３の本発明に係る陽極酸化時の概略図である。
【図６】　図６は実施例４に係る本発明の液晶表示装置を示す図である。
【図７】　図７は実施例４に係る本発明の液晶表示装置の等価回路を示す図である。
【図８】　図８は実施例５に係る本発明の液晶表示装置を示す図である。
【図９】　図９は実施例５に係る本発明の液晶表示装置を示す図である。
【図１０】　図１０は実施例６に係る本発明の液晶表示装置を示す図である。
【図１１】　図１１は実施例７に係る本発明の液晶表示装置を示す図である。
【図１２】　図１２は実施例８に係る本発明の液晶表示装置を示す図である。
【図１３】　図１３は実施例８に係る本発明の液晶表示装置を示す図である。
【図１４】　図１４は実施例９に係る本発明の液晶表示装置を示す図である。
【図１５】　図１５は実施例９に係る本発明の液晶表示装置を示す図である。
【図１６】　図１６は従来の液晶表示装置を示す図で有る。
【符号の説明】
１０１、２０１、４０１、６０１、７０１…第１基板
１０２、２０２、４０２、７０２…第２基板
１０３、２０３、４０３、７０３…第１導電体
１０４、２０４、４０４、７０５…絶縁体
１０５、４０７、５０７、７０６、９０５、１００５、１１０５、１２１１、１７０３…第一画素電極
１０６、４０６、５０８、７０７、９０６、１００６、１１０６、１２１２、１７０４…第二画素電極
１２１３…第三画素電極
１２１４…第四画素電極
１３１１、１３３１、１４１１、１４３１、１５１１、１６１１…櫛歯状第一画素電極
１３１２、１３３２、１４１２、１４３２、１５１２、１６１２…櫛歯状第二画素電極
１０８、２０６、７０８、８０２…データ線
１０９、１１２、１１３、１１４、２０７、４０９、４１５、４１６、４１７、７０９、８０６、８０７…液晶層
１１１、４１０、５０９、７１０、８０３、９１１、１０１１、１１１１、１２０１、１３０１、１３２１、１４０１、１４２１、１７０５…第一ＭＩＭ素子
１１０、４１１、５１０、７１１、８０４、９１０、１０１０、１１１０、１２０２、１３０２、１３２２、１４０２、１４２２、１７０６…第二ＭＩＭ素子
１２０３…第三ＭＩＭ素子
１２０４…第四ＭＩＭ素子
２０５…液晶駆動電極
２０８…ＭＩＭ素子
４０５…第三画素電極
４１２、７１２、８０５…第三ＭＩＭ素子
４０８、５０６、８０１…走査配線
４１３、４１４…矢印
５０１、６０２…第１データ線
５０２、６０３…第２データ線
５０３…第１絶縁体
５０４…第２絶縁体
５１１、６０４…端子エリア
５０５…パット電極
６０５…第１陽極酸化パット
６０６…第２陽極酸化パット
６０７、６０８…破線
７０４…第３導電体
１０１５、１０１６…第二導電体
１７０１…対向電極
１７０２…配線
１５０１、１６０１…第一薄膜トランジスタ
１５０２、１６０２…第二薄膜トランジスタ
１５２…走査線
１５３…信号線
１６２１…第一走査線
１６２２…第二走査線
１６３…信号線

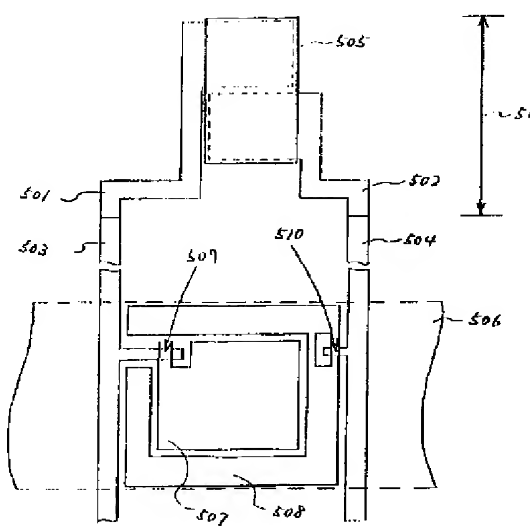
【図1】


108
A'
106
d
105
111
110
104
A
(a)
102
112
108
113
109
A
A'
114
106
105
104
103
105
106
101
(b)

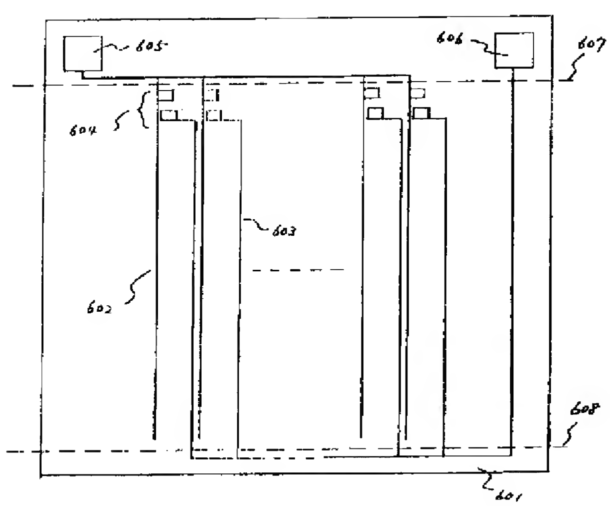
【図2】


206
205
208
B
B'
204
(a)
202
206
207
B
B'
204
205
203
201
(b)

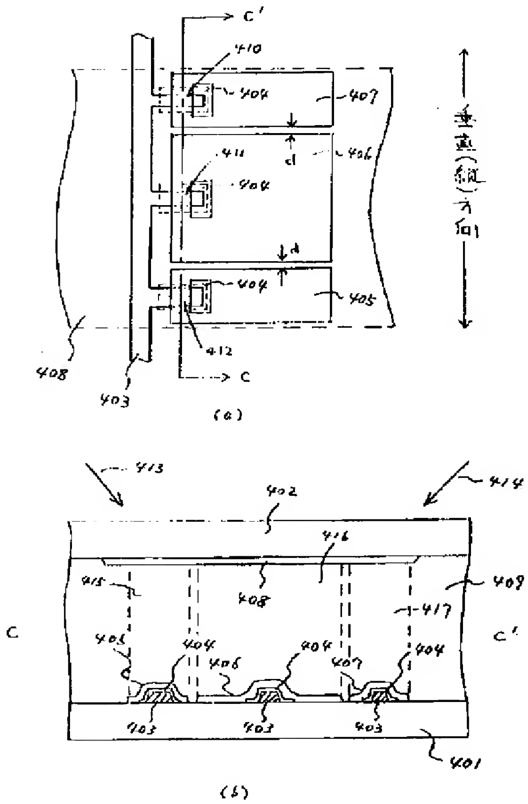
【図4】


505
511
501
502
503
504
509
510
506
507
508

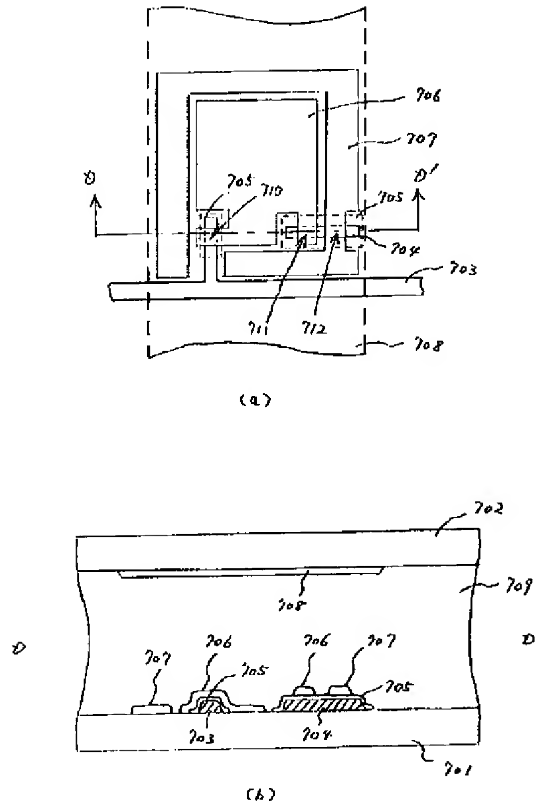
【図5】


605
606
607
604
603
602
608
601

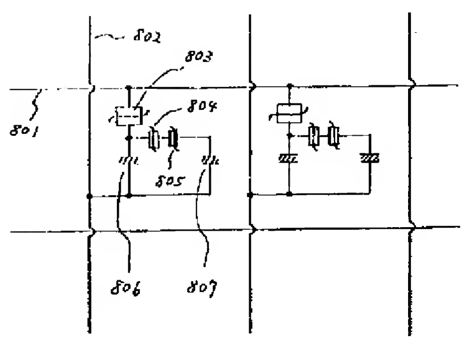
【図３】


C'
410
404
407
411
406
d
垂直(縦)方向
405
412
408
403
C
(a)
413
414
402
416
415
409
417
C'
401
(b)

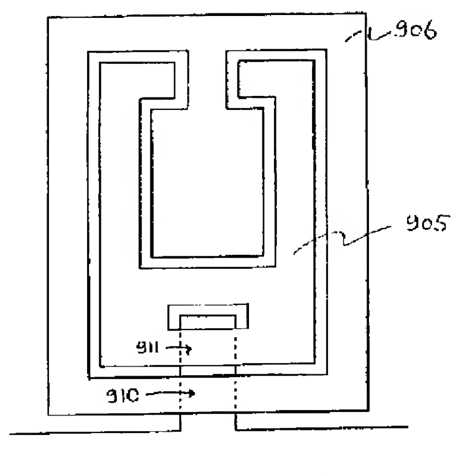
【図６】


706
707
D
D'
705
710
704
703
711
712
708
(a)
702
709
(b)

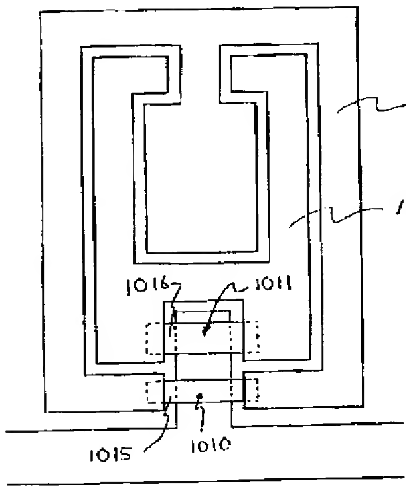
【図７】


802
803
801
804
805
806
807

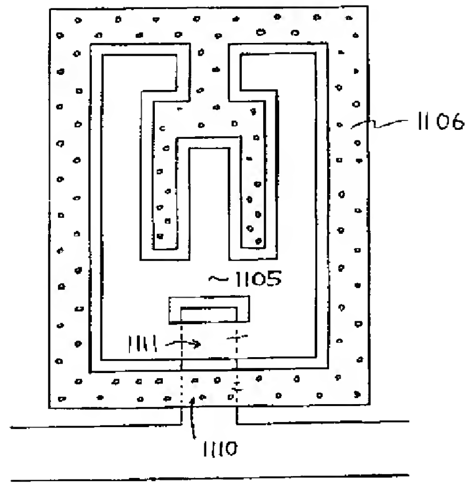
【図８】


906
905
911
910

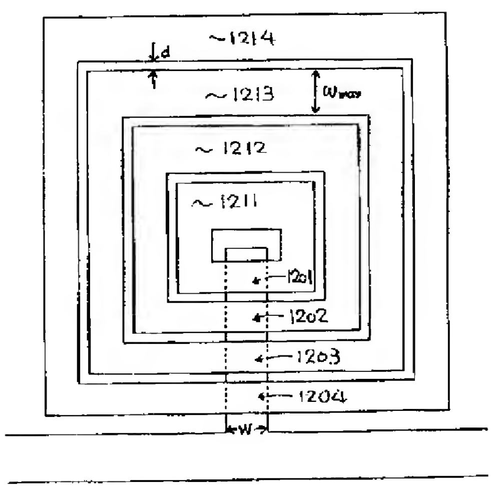
【図9】



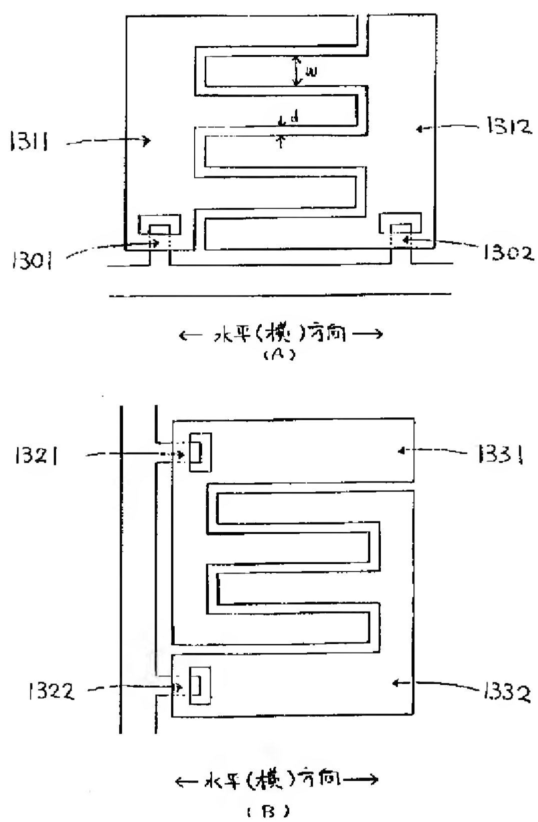
【図10】



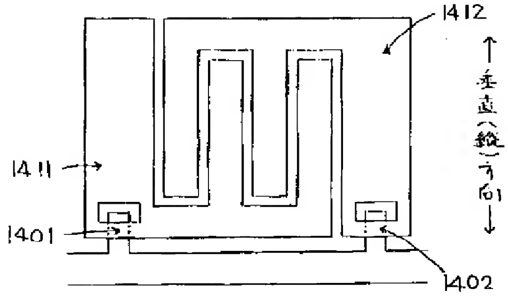
【図11】



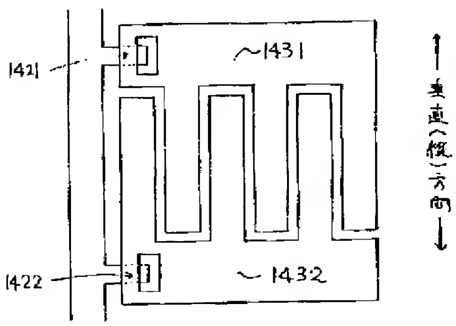
【図12】



【図１３】

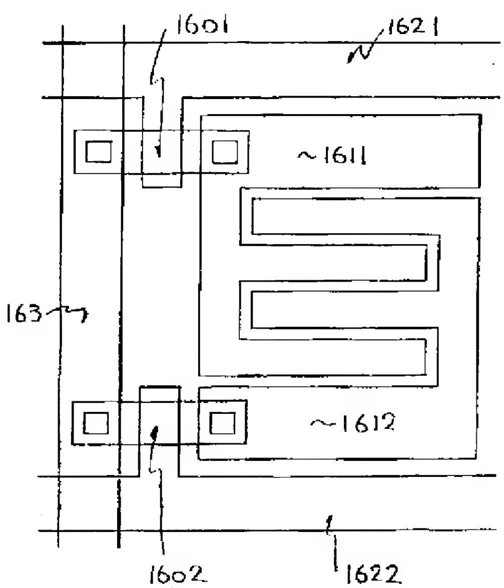


(A)

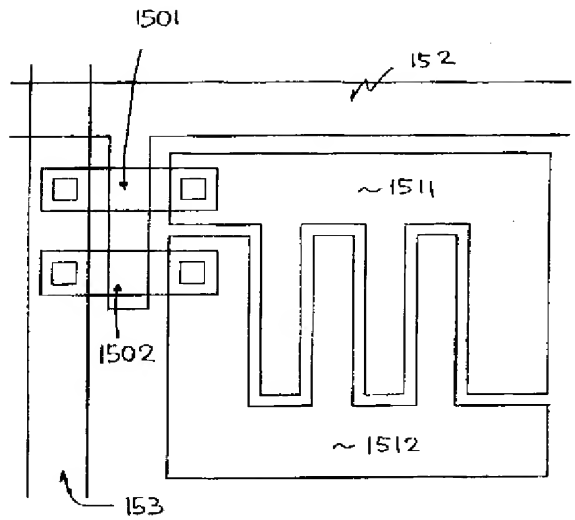


(B)

【図１５】



【図１４】



【図１６】